# **Appendices**

# A. Discussion on the choice of Proximal Policy Optimization as a baseline

A general learning process of RL can be described using policy iteration, which consists of two iterative phases: policy evaluation and policy improvement (Sutton & Barto, 1998). In policy iteration, the value function is assumed to be exact, meaning that given policy, the value function is learned until convergence for the entire state space, which results in a strong bound on the rate of convergence to the optimal value and policy (Puterman, 1994).

But the exact value method is often infeasible from resource limitation since it requires multiple sweeps over the entire state space. Therefore, in practice, the value function is approximated, i.e. it is not trained until convergence nor across the entire state space on each iteration. The approximate version of the exact value function method, also known as *asynchronous value iteration*, still converges to the unique optimal solution of the Bellman optimality operator. However, the Bellman optimality only describes the limit convergence, and thus the best we can practically consider is to measure the improvement on each update step.

Bertsekas & Tsitsiklis (1996) have shown that, when we approximate the value function  $V_{\pi}$  of some policy  $\pi$  with  $\tilde{V}$ , the lower bound of a greedy policy  $\pi'$  is given by

$$V_{\pi'}(x) \ge V_{\pi}(x) - \frac{2\gamma\varepsilon}{1 - \gamma},\tag{22}$$

where  $\varepsilon=\max_x |\tilde{V}(x)-V_\pi(x)|$  is the  $L_\infty$  error of value approximation  $\tilde{V}$ . This means a greedy policy from an approximate value function guarantees that its exact value function will not degrade more than  $\frac{2\gamma\varepsilon}{1-\gamma}$ . However, there is no guarantee on the improvement, i.e.  $V_{\pi'}(x)>V_\pi(x)$  (Kakade & Langford, 2002).

As a solution to this issue, Kakade & Langford (2002) have proposed a policy updating scheme named *conservative policy iteration*,

$$\pi_{new}(a|x) = (1 - \alpha)\pi_{old}(a|x) + \alpha\pi'(a|x),\tag{23}$$

which has an explicit lower bound on the improvement

$$\eta(\pi_{new}) \ge L_{\pi_{old}}(\pi_{new}) - \frac{2\epsilon\gamma}{(1-\gamma)^2}\alpha^2,\tag{24}$$

where  $\epsilon = \max_x |\mathbb{E}_{\pi'}[A_{\pi}(x, a)]|$ ,  $A_{\pi}(x, a) = Q(x, a) - V(x)$  is the advantage function,  $\eta(\pi)$  denotes the expected sum of reward under the policy  $\pi$ ,

$$\eta(\pi) = \mathbb{E}\left[\sum_{t=0}^{\infty} \gamma^t R(x_t, a_t)\right],\tag{25}$$

and  $L_{\pi_{old}}$  is the local approximation of  $\eta$  with the state visitation frequency under the old policy.

From the definition of distributional Bellman optimality operator in (6), one can see that the lower bound in (24) also holds when  $\pi'$  is greedy with respect to the expectation of the value distribution, i.e.,  $\mathbb{E}_{x'\sim P}[Z(x',a')]$ . Thus the improvement of the distributional Bellman update is guaranteed in expectation under conservative policy iteration, and the value functions are guaranteed to converge in distribution to a fixed point by  $\gamma$ -contraction.

Schulman et al. (2015) takes this further, suggesting an algorithm called trust region policy optimization (TRPO), which extends conservative policy iteration to a general stochastic policy by replacing  $\alpha$  with Kullback-Leibler (KL) divergence between two policies,

$$D_{KL}^{max}(\pi, \tilde{\pi}) = \max_{x} D_{KL}(\pi(\cdot|x)||\tilde{\pi}(\cdot|x)).$$
(26)

Then, the newly formed objective is to maximize the following, which is a form of constraint optimization with penalty:

$$\hat{\mathbb{E}}_t \left[ \frac{\pi(a_t|x_t)}{\tilde{\pi}(a_t|x_t)} \hat{A}_t - \beta D_{KL}(\pi(\cdot|x_t), \tilde{\pi}(\cdot|x_t)) \right] = \hat{\mathbb{E}}_t \left[ r_t(\pi) \hat{A}_t - \beta D_{KL}(\pi(\cdot|x_t), \tilde{\pi}(\cdot|x_t)) \right]. \tag{27}$$

where  $r(\pi)$  refers to the ratio  $r(\pi) = \frac{\pi(a_t|x_t)}{\tilde{\pi}(a_t|x_t)}$ . However, in practice, choosing a fixed penalty coefficient  $\beta$  is difficult and thus Schulman et al. (2015) uses hard constraint instead of the penalty.

$$\max_{\alpha} \hat{\mathbb{E}}_t \left[ r_t(\pi) \hat{A}_t \right] \tag{28}$$

s.t. 
$$D_{KL}(\pi(\cdot|x_t), \tilde{\pi}(\cdot|x_t)) \le \delta$$
 (29)

Schulman et al. (2017) simplifies the loss function even further in proximal policy optimization (PPO) by replacing KL divergence with ratio clipping between the old and the new policy with the following:

$$L^{CLIP} = \hat{\mathbb{E}}_t \left[ \min \left( r_t(\pi) \hat{A}_t, \operatorname{clip}(r_t(\pi), 1 - \epsilon, 1 + \epsilon) \hat{A}_t \right) \right]. \tag{30}$$

Thus, by using PPO as the baseline, we aim to optimize the value function via unique point convergence of distributional Bellman operator for a policy being approximately updated under the principle of conservative policy.

# **B.** Expectation value of $Z_t^{(\lambda)}$

Continuing from (13), let us define a random variable that has a cumulative distribution function of  $\mathbb{E}[\tilde{F}_Z]$  as  $Z_t^{(\lambda)}$ . Then, its cumulative distribution function is given by

$$F_{Z_t^{(\lambda)}} = (1 - \lambda) \sum_{n=1}^{\infty} \lambda^{n-1} F_{Z_t^{(n)}}.$$
(31)

If we assume that the support of  $Z_t^{(\lambda)}$  is defined in the extended real line  $[-\infty, \infty]$ ,

$$\mathbb{E}[Z_t^{(\lambda)}] = \int_0^\infty \left(1 - F_{Z_t^{(\lambda)}}\right) dz - \int_{-\infty}^0 F_{Z_t^{(\lambda)}} dz \tag{32}$$

$$= \int_0^\infty \left( 1 - (1 - \lambda) \sum_{n=1}^\infty \lambda^{n-1} F_{Z_t^{(n)}} \right) dz - \int_{-\infty}^0 (1 - \lambda) \sum_{n=1}^\infty \lambda^{n-1} F_{Z_t^{(n)}} dz$$
 (33)

$$= (1 - \lambda) \sum_{n=1}^{\infty} \lambda^{n-1} \left[ \int_0^{\infty} \left( 1 - F_{Z_t^{(n)}} \right) dz - \int_{-\infty}^0 F_{Z_t^{(n)}} dz \right]$$
 (34)

$$= (1 - \lambda) \sum_{n=1}^{\infty} \lambda^{n-1} G_t^{(n)} = G_t^{(\lambda)}.$$
 (35)

Thus we can arrive at the desired expression of  $\mathbb{E}[Z_t^{(\lambda)}] = G_t^{(\lambda)}$ .

# C. Distributional Bellman operator as a contraction in Cramér metric space

The Cramér distance possesses the following characteristics (detailed derivation of each can be found in (Bellemare et al., 2017b)):

$$l_p(A+X,A+Y) \le l_p(X,Y),$$
  $l_p(cX,cY) \le |c|^{1/p} l_p(X,Y).$  (36)

Using the above characteristics, the Bellman operator in  $l_n$  divergence is

$$l_{p}\left(\mathcal{T}^{\pi}Z_{1}(x,a),\mathcal{T}^{\pi}Z_{2}(x,a)\right) = l_{p}\left(R(x,a) + \gamma P^{\pi}Z_{1}(x,a), R(x,a) + \gamma P^{\pi}Z_{2}(x,a)\right)$$

$$\leq |\gamma|^{1/p}l_{p}\left(P^{\pi}Z_{1}(x,a), P^{\pi}Z_{2}(x,a)\right)$$

$$\leq |\gamma|^{1/p}\sup_{x',a'}l_{p}\left(Z_{1}(x',a'), Z_{2}(x',a')\right).$$
(37)

Substituting the result into the definition of the maximal form of the Cramér distance yields

$$\bar{l}_p(\mathcal{T}^{\pi} Z_1, \mathcal{T}^{\pi} Z_2) = \sup_{x, a} l_p(\mathcal{T}^{\pi} Z_1(x, a), \mathcal{T}^{\pi} Z_2(x, a))$$

$$\leq |\gamma|^{1/p} \sup_{x', a'} l_p(Z_1(x', a'), Z_2(x', a'))$$

$$= |\gamma|^{1/p} \bar{l}_p(Z_1, Z_2).$$
(38)

Thus the distributional Bellman operator is a  $|\gamma|^{1/p}$ -contraction mapping in the Cramér metric space, which was also proven in Rowland et al. (2019).

Similar characteristics as in (36) can be derived for the energy distance

$$\mathcal{E}(A+X,A+Y) \le \mathcal{E}(X,Y), \qquad \qquad \mathcal{E}(cX,cY) = c\mathcal{E}(X,Y), \tag{39}$$

showing that the distributional Bellman operator is a  $\gamma$ -contraction in energy distance

$$\mathcal{E}(\mathcal{T}^{\pi}Z_1, \mathcal{T}^{\pi}Z_2) \le \gamma \mathcal{E}(Z_1, Z_2). \tag{40}$$

#### **D.** Loss Functions

As in other policy gradient methods, our value distribution approximator models the distribution of the value,  $V(x_t)$ , not the state-action value  $Q(x_t, a_t)$ , and denote it as  $Z_{\theta}(x_t)$  parametrized with  $\theta$ , whose cumulative distribution function is defined as

$$F_{Z_{\theta}(x_t)} = \sum_{a \in A} \pi(a, x_t) F_{Z(x_t, a)}.$$
 (41)

Below, we provide the complete loss function of value distribution approximation for each of the cases used in experiments (Section 5).

### D.1. Implicit Quantile + Huber quantile (IQAC)

For the value loss of IQAC, we follow the general flow of Huber quantile loss described in Dabney et al. (2018b). For two random samples  $\tau, \tau' \sim U([0,1])$ ,

$$\delta_t^{\tau,\tau'} = Z_t^{(\lambda)}(x_t, a_t; \tau') - Z_\theta(x_t; \tau) \tag{42}$$

where  $Z_t^{(\lambda)}$  is generated via  $SR(\lambda)$  and  $Z(x;\tau)=F_Z^{-1}(\tau)$  is realization of Z(X) given X=x and  $\tau$ . Then, the full loss function of value distribution is given by

$$L_{Z_{\theta}} = \frac{1}{N'} \sum_{i=1}^{N} \sum_{j=1}^{N'} \rho_{\tau_i}^{\kappa} \left( \delta_t^{\tau_i, \tau_j'} \right)$$
 (43)

where N and N' are number of samples of  $\tau$ ,  $\tau'$ , respectively, and  $\rho$  is the Huber quantile loss

$$\rho_{\tau}^{\kappa}(\delta_{ij}) = |\tau - \mathbb{I}\{\delta_{ij} < 0\}| \frac{L_{\kappa}(\delta_{ij})}{\kappa}, \quad \text{with}$$
(44)

$$L_{\kappa}(\delta_{ij}) = \begin{cases} \frac{1}{2}\delta_{ij}^{2}, & \text{if } |\delta_{ij}| \leq \kappa \\ \kappa(|\delta_{ij}| - \frac{1}{2}\kappa), & \text{otherwise.} \end{cases}$$

$$(45)$$

#### D.2. Implicit Quantile + Energy Distance (IQAC-E)

Here, we replace the Huber quantile loss in (43) with sample-based approximation of energy distance defined in (20).

$$L_{Z_{\theta}} = \frac{2}{NN'} \sum_{i=1}^{N} \sum_{j=1}^{N'} \left| \delta_{t}^{\tau_{i}, \tau_{j}'} \right| - \frac{1}{N^{2}} \sum_{i=1}^{N} \sum_{i'=1}^{N} \left| \delta_{t}^{\tau_{i}, \tau_{i'}} \right| - \frac{1}{N'^{2}} \sum_{j=1}^{N'} \sum_{j'=1}^{N'} \left| \delta_{t}^{\tau_{j'}', \tau_{j}'} \right|$$
(46)

#### D.3. Gaussian Mixture + Energy Distance (GMAC)

Unlike the two previous losses, which use samples at  $\tau$  generated by the implicit quantile network  $Z_{\theta}(x_t;\tau)$ , here we discuss a case in which the distribution is k-component Gaussian mixture parameterized with  $(\mu_k, \sigma_k^2, w_k)$ .

Using the expectation of a folded normal distribution, we define  $\delta$  between two Gaussian distributions as

$$\delta(\mu_i, \sigma_i^2, \mu_j, \sigma_j^2) = \sqrt{\frac{2}{\pi}} \sqrt{\sigma_i^2 + \sigma_j^2} \exp\left(-\frac{(\mu_i - \mu_j)^2}{2(\sigma_i^2 + \sigma_j^2)}\right) + (\mu_i - \mu_j) \left[1 - 2\Phi\left(\frac{(\mu_i - \mu_j)}{\sqrt{2}}\right)\right]. \tag{47}$$

Let  $Z_{\theta}(x)$  and  $Z_{t}^{(\lambda)}$  be Gaussian mixtures parameterized with  $(\mu_{\theta i}, \sigma_{\theta i}^{2}, w_{\theta i}), (\mu_{\lambda j}, \sigma_{\lambda j}^{2}, w_{\lambda j})$ , respectively. Then, the loss function for the value head is given by

$$L_{Z_{\theta}} = \frac{2}{NN'} \sum_{i=1}^{N} \sum_{j=1}^{N'} w_{\theta i} w_{\lambda j} \delta(\mu_{\theta i}, \sigma_{\theta i}^{2}, \mu_{\lambda j}, \sigma_{\lambda j}^{2})$$

$$-\frac{1}{N^{2}} \sum_{i=1}^{N} \sum_{i'=1}^{N} w_{\theta i} w_{\theta i'} \delta(\mu_{\theta i}, \sigma_{\theta i}^{2}, \mu_{\theta i'}, \sigma_{\theta i'}^{2})$$

$$-\frac{1}{N'^{2}} \sum_{j=1}^{N'} \sum_{j'=1}^{N'} w_{\lambda j} w_{\lambda j'} \delta(\mu_{\lambda j}, \sigma_{\lambda j}^{2}, \mu_{\lambda j'}, \sigma_{\lambda j'}^{2}).$$
(48)

#### E. Pseudocode of GMAC

#### Algorithm 2 Pseudocode of GMAC

**Input:** Initial policy parameters  $\theta_0$ , initial value function parameters  $\phi_0$ , length of trajectory N, number of environments E, clipping factor  $\epsilon$ , discount factor  $\gamma$ , weight parameter  $\lambda$ 

#### repeat

 $\mathbf{for}\ e=1\ \mathbf{to}\ E\ \mathbf{do}$ 

Collect samples of discounted sum of rewards  $\{Z_1, \ldots, Z_N\}$  by running policy  $\pi_k = \pi(\theta_k)$  in the environment Compute the parameters  $(\mu_i, \sigma_i, w_i)$  for each of the  $\lambda$ -returns  $\{Z_1^{(\lambda)}, \ldots, Z_{N-1}^{(\lambda)}\}$  by  $SR(\lambda)$  (Algorithm 1)

Compute advantage estimates  $\hat{A}_t$  using GAE (Schulman et al., 2016), based on the current value function  $V_{\phi_k}$  end for

Gather the data from E environments

Update policy using the clipped surrogate loss:

$$\theta_{k+1} = \arg\max_{\theta} \mathbb{E}\left[\min\left(\frac{\pi_{\theta}(a_t|s_t)}{\pi_{\theta_k}(a_t|s_t)}\hat{A}_t, \ g(\epsilon, \hat{A}_t)\right)\right]$$

via stochastic gradient ascent.

Update value function using the energy distance between Gaussian mixtures (Equation 20):

$$\phi_{k+1} = \operatorname*{arg\,min}_{\phi} \mathbb{E}\left[\mathcal{E}\left(V_{\phi}(s_t), Z_t^{(\lambda)}\right)\right]$$

via stochastic gradient descent.

until Final update step

The clipping function  $g(\epsilon, A)$  shown in the algorithm is defined as follows:

$$g(\epsilon, A) = \begin{cases} (1+\epsilon)A & \text{if } A \ge 0\\ (1-\epsilon)A & \text{if } A < 0 \end{cases}$$

Note that expectation of each loss is taken over the collection of trajectories and environments.

## F. Implementation Details

For producing a categorical distribution, a softmax layer was added to the output of the network. For producing a Gaussian mixture distribution, the mean of each Gaussian is simply the output of the network, the variance is kept positive by running the output through a softplus layer, and the weights of each Gaussian is produced through the softmax layer. Since

Layer Type	Spe	ecifications	Filter size, stride	
Input	84	1 x 84 x 4		
Conv1	20	x 20 x 32	8 x 8 x 32, 4	
Conv2	9	x 9 x 64	4 x 4 x 64, 2	
Conv3	7	x 7 x 32	3 x 3 x 32, 1	
FC1	512			
Heads	Policy	Value		
(FC)	action dim	# of modes $(=5)$		

Table 2: Network architecture for GMAC on atari

our proposed method takes an architecture which only changes the value head of the original PPO network, we base our hyperparameter settings from the original paper (Schulman et al., 2017). We performed a hyperparameter search on a subset of variables: optimizers={Adam, RMSprop}, learning rate={2.5e-4, 1.0e-4}, number of epochs={4, 10}, batch size={256, 512}, and number of environments={16, 32, 64, 128} over 3 atari tasks of Breakout, Gravitar, and Seaquest, for which there was no degrade in the performance of PPO.

Task			Atari				PyBullet	
Parameter	PPO	IQ	IQAC-E	GMAC	PPO	IQ	IQAC-E	GMAC
Learning rate			2.5e-4				1e-4	
Optimizer			Adam				Adam	
Total frames	2e8			5e7				
Rollout steps	128			512				
Skip frame			4				1	
Environments			64				64	
Minibatch size			512				2048	
Epoch			4				10	
$\gamma$			0.99				0.99	
$\lambda$			0.95				0.95	
Dirac samples			64		T -		64	
Mixtures	-	-	-	5	-	-	-	5

Table 3: Parameter settings for training Atari games and PyBullet tasks

# **G.** More Experimental Results

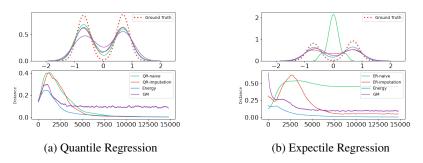


Figure 6: In addition to Figure 3, quantile and expectile regressions are also evaluated in the 5-state MDP against IQE and GMM with their respective loss functions.

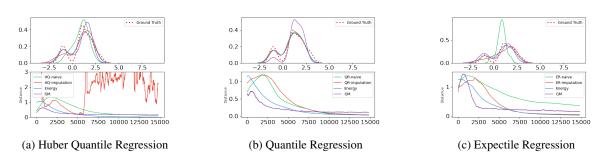


Figure 7: Evaluation of the five-state MDP under tabular setting on a asymmetric reward distribution). Huber quantile( $\kappa = 1$ ), quantile, and expectile regressions are compared to the energy distance minimization between samples and Gaussian mixtures.

Here we provide more details on the five-state MDP presented in Figure 3. For each cases in the figure, 15 diracs are used for quantile based methods and 5 mixtures are used for GMM to balance the total number of parameters required to represent a distribution. For the cases with the label "naive", the network outputs (quantiles, expectiles, etc.) are used to create the plot. On the other hand, the cases with "imputation" labels apply appropriate imputation strategy to the statistics to produce samples which are then used to plot the distribution. Sample based energy-distance was used to calculate the distance from the true distribution for all cases.

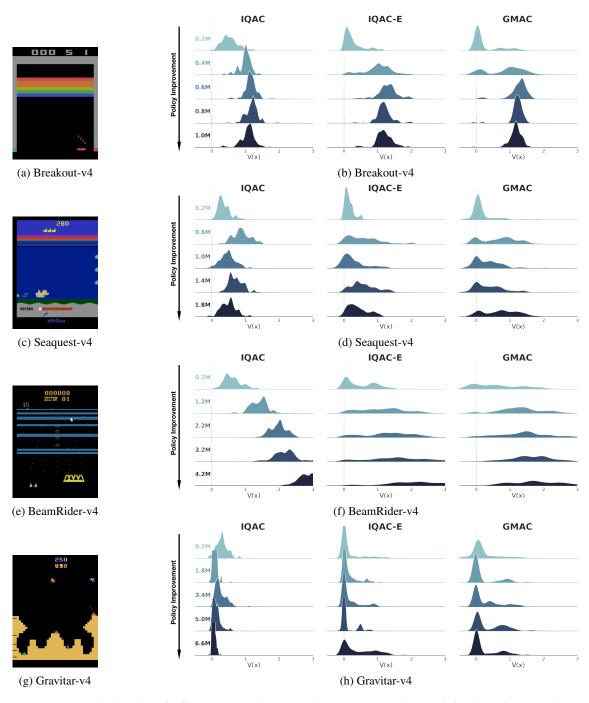


Figure 8: More value distributions of different tasks. All states are chosen such that the agent is in place of near-death or near positive score. Thus, when the policy is not fully trained, such as in a very early stage, the value distribution should include a notion of death indicated by a mode positioned at zero. In all games, IQN + Huber quantile (IQAC) fails to correctly capture a mode positioned at zero while the other two methods, IQN + energy distance (IQAC-E) and GMM + energy distance (GMAC) captures the mode in the early stage of policy improvement. Again, the visual representation is maxpool of the 4 frame stacks in the given state.

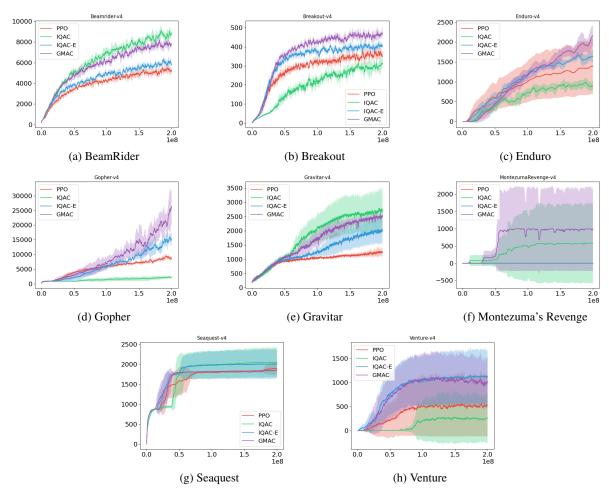


Figure 9: Raw learning curves over 5 random seeds for 8 selected Atari games. The y-axis is raw score and x-axis is in frames. The tasks are selected considering the stochasticity in games, score gap between the previous scalar and distributional method (DQN (Mnih et al., 2015) vs. IQN (Dabney et al., 2018a)), and complexity of the game in terms of exploration.

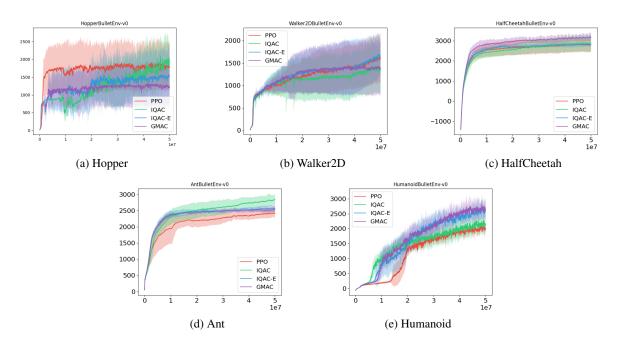


Figure 10: Raw learning curves over 5 random seeds for 5 selected PyBullet continuous control tasks. The y-axis is in raw score and x-axis is in environment steps.

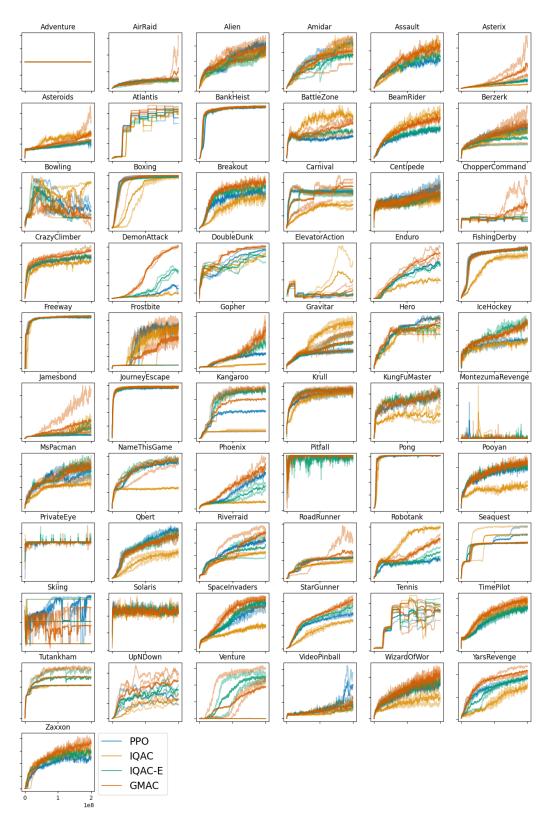


Figure 11: Full learning curves of 61 atari games from ALE

*Table 4:* Average score over last 100 episodes in 200M frame collected for training 61 atari games. The algorithms are trained using same single seed and hyperparameters. Random and Human scores are taken from Wang et al.

Adventure	GAMES	RANDOM	HUMAN	PPO	IQAC	IQAC-E	GMAC
Asien	Adventure	NA	NA	0.00	0.0	0.00	0.00
Assault 22.40	AirRaid	NA	NA	10,205.75	8,304.50	7,589.50	62,328.75
Asterix 210.0 8,503.30 13,357.00 6,588.00 15,456.00 22,569.75   Asteriodis 719.10 47,388.70 2,088.10 3,428.10 2,332.00 2,597.50   Allamis 12,850.00 29,028.10 3,073,796.00 5,868.00 15,426.00 22,569.75   BankHeist 14,20 753.10 1,263.80 1,265.80 1,286.60 12,273.00 2,597.50   BankHeist 14,20 753.10 1,263.80 1,265.80 1,286.60 1,274.54 0   BankHeist 14,20 753.10 1,263.80 1,748.10 1,682.70 1,263.80 1,281.20 1,276.80 1,748.10 1,748.10 1,748.10 1,748.10 1,748.70 1,749.10 1,74	Alien	227.80	7,127.70	2,918.60	2,505.80	2,704.20	3,687.10
Asterix	Amidar	5.80	1,719.50	1,244.12	1,210.40	932.11	1,363.72
Asteroids Alamis 12,8500 29,026,10 30,73,796,00 2,916,20 3,373,635,00 31,145,00 BankHeist 14,20 753,10 1,263,80 1,265,80 1,286,60 1,274,30 BattleZone 2,360,00 37,187,50 1,854,00 35,160,00 21,310,00 32,490,00 BeamRider 365,90 16,926,50 5,913,84 8,968,58 6,507,68 8,718,72 Bowling 23,10 16,070 33,54 65,81 30,00 19,39 Bowing 0.10 12,10 96,79 97,84 97,10 99,89 Breakout 1,70 30,50 384,29 296,91 445,64 462,68 Camival NA NA 5,079,20 2,865,40 4,401,00 6,344,20 Camival NA NA 5,079,20 2,865,40 4,401,00 6,344,20 Camival Rill No 7,387,90 872,00 1,096,00 1,314,00 1,795,00 DemonAttack 152,10 1,971,00 50,590,65 40,369,90 236,83 82 141,183,50 DoubleDunk 18,60 16,40 3,26 6,30 8,28 2.772 ElevatorAction NA NA 104,49,00 50,00 8,516,00 125,143,00 Enduro 0.00 860,50 1,588,68 861,65 1,612,17 2,092,65 FishingDerby -91,70 -38,70 37,01 1,906,00 1,334,60 14,254,00 Gravitar 173,00 3,381,40 1,151,50 2,798,00 2,178,50 2,2401,00 Enduckey 173,00 30,28,64 30,375,10 30,710 30,33,24 0 3,331,34 3,351,40 Hero 1,027,00 30,286,40 37,275,55 12,686,50 4,303,69 9,153,00 1,512,00 Printil 1,598,00 1,500,00 4,733,00 0,00 2,785,00 1,742,00 2,368,00 2,178,50 2,401,00 Printil 1,598,00 1,500,00 1,500,00 4,763,30 9,00 4,762,00 1,742,00 2,368,00 2,178,50 2,401,00 Printil 1,598,00 1,665,50 9,665,51 8,643,09 9,514,00 3,378,00 Printil 1,598,00 1,600,00 1,345,00 Printil 1,598,00 1,600,00 1,345,00 Printil 1,20 0,90 -1.90 -1.98 1,198 2,13 0,34 0,191,191,191,191,191,191,191,191,191,19	Assault	222.40	742.00		12,053.03	8,589.55	10,281.73
Atlantis         12,850,00         29,028,10         3,073,796,00         2,916,292,00         3,373,635,00         3,141,534,00           BankHeist         14,20         753,10         1,263,80         1,265,80         1,286,60         22,490,00         32,400,00         33,54         65,81         30,00         19,39         39,99         32,112,10         19,70         30,50         384,29         29,691         445,64         462,68         462,68         462,68         443,54         462,68         462,68         462,68         48,303,10         10,795,00         21,510         10,795,00         32,510         10,910         50,502,52         4,864,69         4,303,10         1,795,00	Asterix	210.00	8,503.30	13,367.00	6,868,00	15,426.00	22,650.00
Bankleist         14.20         753.10         1,263.80         1,265.80         1,286.60         1,274.30           BattleZone         2,360.00         37,187.50         18,540.00         35,160.00         21,310.00         32,490.00           Berzerk         123.70         2,630.40         1,748.10         1,682.70         887.50         3,081.20           Bowling         23.10         160.70         33.54         65.81         30.00         19.39           Boxing         0.10         12.10         96.79         97.84         97.10         99.89           Breakout         1.70         30.50         384.29         96.91         445.64         462.68           Carnival         NA         NA         5.079.20         2.865.40         4.401.00         6,344.20           ChoperCommand         10.780.50         35.829.40         112,640.00         107,375.00         121,550.00         125,143.00           DemonAttack         152.10         1,971.00         50.50.65         40.369.90         236,839.85         411,118.85           DoubleDunk         -18.60         -16.40         -3.26         -6.30         -8.28         -2.72           ElevatorAction         NA         NA         10,	Asteroids	719.10	47,388.70	2,088.10	3,428.10	2,332.00	2,597.50
BattleZone   BeamRider   363.90   16.926.50   5.913.84   8.968.58   6.507.68   8.718.72	Atlantis	12,850.00	29,028.10	3,073,796.00	2,916,292.00	3,373,635.00	3,141,534.00
BeamRider   363.90   16.926.50   5.913.84   8,968.58   6.507.68   8,718.72     Berzerk   123.70   2,630.40   1,748.10   1,682.70   887.50   3,081.20     Boxing   0.10   12.10   96.79   97.84   97.10   99.89     Breakout   1.70   30.50   38.42.9   296.91   445.64   462.68     Carnival   NA	BankHeist	14.20	753.10	1,263.80	1,265.80	1,286.60	
Berzerk   123.70   2,630.40   1,748.10   1,682.70   887.50   3,081.20	BattleZone	2,360.00	37,187.50	18,540.00	35,160.00	21,310.00	32,490.00
Bowling Boxing Boxing Breakout         23.10         160.70         33.54         65.81         30.00         19.39           Breakout Carnival Carnival Centipede Command Chary Climber Lorge DemonAttack Centipede Chopper Command State Carnival Crary Climber 10,780.50         NA         NA         5,079.20         2,865.40         4,401.00         6,344.20           Chopper Command Crazy Climber DemonAttack DemonAttack DemonAttack Induction Command Crazy Climber Lorge Carnival Crary Climber 152.10         1,971.00         35,829.40         112,640.00         10,7375.00         121,550.00         1,795.00         8.2.8         1,725.00         1,795.00         1,795.00         8.2.8         1,725.00         1,795.00         8.2.8         1,725.00         1,795.00         8.2.8         1,725.00         3,735.00         1,795.00         3,735.00         1,795.00         8.2.8         1,725.00			16,926.50		8,968.58		
Boxing Breakout         0.10         12.10         96.79         97.84         97.10         99.89           Breakout         1.70         30.50         384.29         296.91         445.64         462.68           Carnival         NA         NA         5.079.20         2.865.40         4,401.00         6.344.20           Chopper Command         10,780.50         35,829.40         112,640.00         107,375.00         121,550.00         125,143.00           DembleDunk         18.60         1-16.40         -3.26         -6.30         -8.28         22.72           ElevatorAction         NA         NA         NA         10,449.00         50.00         8.516.00         14,254.00           FishingDerby         -91.70         -38.70         37.01         9.12         33.13         37.52           Freeway         0.00         29.60         32.53         32.96         33.68         32.84           Gopher         257.60         2,412.50         8,199.80         2,932.20         16,934.60         25,266.80           Gravitar         173.00         30,826.40         13,725.55         32,568.50         2,178.50         2,400.00           Jamesbond         29.00         30,280							'
Breakout   1.70	_		1				
Carnival Centipede         NA 2,090,90         12,017.00         5,205.25         4,085.38         4,401.00         6,344.20           ChopperCommand CrazyClimber         10,780.50         35,829.40         112,640.00         10,960.00         1,314.00         1,795.00           DemonAttack DoubleDunk         152.10         1,971.00         50,590.65         40,369.90         236,839.85         2-2.72           ElevatorAction         NA         NA         10,449.00         50.00         8,516.00         142,254.00           Enduro         0.00         860.50         1,588.68         861.65         1,612.17         33.13         37.52           Freeway         0.00         29.60         32.53         32.96         33.68         32.84           Frostbite         62.50         4,334.70         3,571.50         3,550.10         307.10         3,392.40           Gopher         257.60         2,412.50         8,199.80         2,932.20         16,934.60         25,266.80           Gravitar         173.00         3,351.40         1,151.50         2,798.00         2,178.50         22,178.50           Jamesbond         29.00         302.80         462.50         4,91.55         43,965.95         41,509.05							
Centipede ChopperCommand CrazyClimber DemonAttack         2,090.90 10,780.50         35,829.40 35,829.40         112,640.00         10,7375.00         123,140.00         1,795.00           DemonAttack DoubleDunk         18.60         1.640         35,829.40         112,640.00         107,375.00         121,550.00         125,143.00           ElevatorAction Enduro         NA         NA         10,449.00         50.00         8,516.00         14,254.00           Einduro         0.00         860.50         1,588.68         861.65         1,612.17         2,092.65           FishingDerby         9-1,70         -38.70         37.01         9.12         33.13         37.52           Freeway         0.00         29.60         32.53         32.96         33.68         32.84           Frostbite         62.50         4,334.70         3,571.50         3,550.10         307.10         3,392.40           Gopher         257.60         2,412.50         8,199.80         2,932.20         16,934.60         25,266.80           Gravitar         173.00         302.80         42.55         32,568.50         43,065.95         41,509.05           Lechockey         -11.20         0.90         -1.90         -1.98         2.13         0.34							
ChopperCommand CrazyClimber         811.00         7,387.90         872.00         1,096.00         1,314.00         1,795.00           DemonAttack DoubleDunk         152.10         1,971.00         50,590.65         40,369.90         236,839.85         411,118.85           DoubleDunk         -18.60         -16.40         -3.26         -6.30         -8.28         2-2.72           ElevatorAction         NA         NA         10,449.00         50.00         8,516.00         114,254.00           ElevatorAction         NA         NA         10,449.00         50.00         8,516.00         114,254.00           FishingDerby         -91.70         -38.70         37.01         9.12         33.13         37.52           Freeway         0.00         29.60         32.53         32.96         33.68         32.84           Frostbite         62.50         4,334.70         3,571.50         3,550.10         307.10         3,392.40           Gopher         257.60         2,412.50         8,199.80         2,932.20         16,934.60         25,266.80           Gravitar         173.00         3,351.40         1,151.50         2,798.00         2,178.50         2,250.68         20.401.00         10         1,192.00				· ·			
CrazyClimber         10,780.50         35,829.40         112,640.00         107,375.00         12,1550.00         125,143.00           DeubleDunk         152.10         1,971.00         50,590.65         40,369.90         236,839.85         411,118.85           DoubleDunk         18.60         -16.40         -3.26         -6.30         -8.28         -2.72           ElevatorAction         NA         NA         10,449.00         50.00         8,516.00         14,254.00           ElevatorPaction         0.00         860.50         1,588.68         861.65         1,612.17         2,092.65           FishingDerby         9-170         -38.70         37.01         9.12         33.13         37.52           Freeway         0.00         29.60         32.53         32.96         33.468         32.84           Frostbite         62.50         4,344.70         35.71.50         3,550.10         307.10         33.92.40           Gopher         257.60         2,412.50         8,199.80         2,932.20         16,934.60         25,266.80           Gravitar         173.00         302.81         37.725.55         32.568.50         43,065.95         41,509.05           IceHockey         -11.20         0.90		l '		· ·			
DemonAttack   152.10   1,971.00   50,590.65   40,369.90   236,839.85   411,118.85   2.772   ElevatorAction   NA NA   NA   10,449.00   50.00   8,516.00   14,253.00   Enduro   0.00   860.50   1,588.68   861.65   1,612.17   2,092.65   33.68   32.84   Frostbire   62.50   43,34.70   3.7.01   9.12   33.13   37.52   Freeway   0.00   29.60   32.53   32.96   33.68   32.84   Frostbire   62.50   4,334.70   3,571.50   3,550.10   307.10   3,392.40   Gopher   257.60   2,412.50   8,199.80   2,932.20   16,934.60   25,266.80   Gravitar   173.00   3,351.40   1,151.50   2,798.00   2,178.50   2,401.00   Hero   1,027.00   30,826.40   37,725.55   32,568.50   43,065.95   41,509.05   LeHockey   -11.20   0.90   -1.90   -1.98   -1.98   2.13   0.34   34   34   34   34   34   34   34							
DoubleDunk   ElevatorAction   NA	•	1 1					1 ′
ElevatorAction   NA   NA   10,449,00   50,00   8,516,00   14,254,00   Enduro   0.00   860,50   1,588,68   861,65   1,612,17   2,092,65   1,5816,00   2,960   32,53   32,96   33,68   32,84   32,84   32,84   32,84   62,50   4,334,70   3,571,50   3,550,10   30,710   3,392,40   32,60   32,53   32,96   33,68   32,84   32							· '
Enduro         0.00         860.50         1,588.68         861.65         1,612.17         2,092.65           FishingDerby         -91.70         -38.70         37.01         9.12         33.13         37.52           Frewibite         62.50         4,34.70         3.571.50         3.550.10         307.10         3,392.40           Gopher         257.60         2,412.50         8,199.80         2,932.20         16,934.60         252,266.80           Gravitar         173.00         3,351.40         1,151.50         2,798.00         2,178.50         2,401.00           Hero         1,027.00         30,826.40         37.725.55         32,568.50         43,065.95         41,509.05           IceHockey         -11.20         0.90         -1.90         -1.98         2.13         0.34           Jamesbond         29.00         302.80         642.50         4,913.50         961.00         1,512.00           Jamesbond         29.00         3,035.00         1,742.00         2,368.00         12,208.00         12,209.00           Krull         1,598.00         2,665.50         26,846.00         12,006.00         33,378.00         31,025.00           MontzumaRevenge         0.00         4,753.30							
FishingDerby         -91.70         -38.70         37.01         9.12         33.13         37.52           Freeway         0.00         29.60         32.53         32.96         33.68         32.84           Frostbite         62.50         4,334.70         3,571.50         3,550.10         307.10         33.92.40           Gopher         257.60         2,412.50         8,199.80         2,932.20         16,934.60         25,266.80           Gravitar         173.00         3,351.40         1,151.50         2,798.00         2,178.50         2,401.00           Hero         1,027.00         30,826.40         37.725.55         32,568.50         43,065.95         41,509.05           IceHockey         -11.20         0.90         -1.90         -1.98         2.13         0.34           Jamesbond         29.00         302.80         642.50         4,913.50         961.00         1,512.00           JourneyEscape         NA         NA         -607.00         -339.00         -840.00         1,512.00           KungFuMaster         NA         NA         -607.00         2,368.00         12,208.00         12,909.00           MsPacman         307.30         6,951.60         3,674.20							l '
Freeway         0.00         29.60         32.53         32.96         33.68         32.84           Frostbite         62.50         4,334.70         3,571.50         3,550.10         307.10         3,392.40           Gopher         257.60         2,412.50         8,199.80         2,932.20         16,934.60         25,266.80           Gravitar         173.00         3,351.40         1,151.50         2,798.00         2,178.50         2,401.00           Hero         1,027.00         30,826.40         37,725.55         32,568.50         43,065.95         41,509.05           IceHockey         -11.20         0.90         -1.90         -1.98         2.13         0.34           Jamesbond         29.00         302.80         642.50         4,913.50         961.00         1,512.00           JourneyEscape         NA         NA         -607.00         -339.00         -840.00         -680.00           Krull         1,598.00         2,665.50         9,605.51         8,643.09         9,514.03         9,127.63           KungFumare         258.50         22,736.50         26,846.00         12,006.00         33,378.00         31,025.00           MontezumaRevenge         0.00         4,753.30			1				1 ′
Frostbite         62.50         4,334.70         3,571.50         3,550.10         307.10         3,392.40           Gopher         257.60         2,412.50         8,199.80         2,932.20         16,934.60         25,266.80           Gravitar         173.00         3,351.40         1,151.50         2,798.00         2,178.50         2,401.00           Hero         1,027.00         30,826.40         37,725.55         32,568.50         43,065.95         41,509.05           IceHockey         -11.20         0.90         -1.90         -1.98         2.13         0.34           Jamesbond         29.00         302.80         642.50         4,913.50         961.00         1,512.00           JourneyEscape         NA         NA         -607.00         -339.00         -840.00         -680.00           KungFuMaster         NA         NA         -607.00         2,368.00         12,208.00         12,909.00           MontezumaRevenge         0.00         4,753.30         0.00         3.00         0.00         33,378.00         31,025.00           MontezumaRevenge         0.00         4,753.30         0.00         3.00         0.00         0.00            MsPacman         307.30         6,951.							
Gopher Gravitar         257.60 173.00         2,412.50 3,351.40         8,199.80 1,151.50         2,932.20 2,798.00         16,934.60 2,178.50         25,266.80 2,401.00           Hero LeHockey         -11.20         0.90         -1.90         -1.98         2,13         0.34           Jamesbond         29.00         302.80         642.50         4,913.50         961.00         1,512.00           JourneyEscape Kangaroo         NA         NA         -607.00         -339.00         -840.00         -680.00           Krull         1,598.00         2,665.50         9,605.51         8,643.09         9,514.03         9,127.63           KungFuMaster MontezumaRevenge MsPacman         20.00         4,753.30         0.00         3.00         0.00         0.00           Mseaman         307.30         6,951.60         3,674.20         2,450.70         4,699.00         3,884.40           Phoenix         761.40         7,242.60         3,7263.70         6,366.20         26,154.00         14,031.30           Poogan         NA         NA         4,018.95         1,819.85         3,674.70         4,178.65           PrivateEye         24.90         69,571.30         100.00         71.51         196.30         100.00           <	•						
Gravitar Hero         173.00 1,027.00         3,351.40 30,826.40         1,151.50 37,725.55         2,798.00 32,568.50         2,178.50 43,065.95         2,401.00 41,509.05           IceHockey         -11.20         0.90         -1.90         -1.98         2.13         0.34           Jamesbond         29.00         302.80         642.50         4,913.50         961.00         1,512.00           JourneyEscape         NA         NA         NA         607.00         -339.00         -840.00         -680.00           Kangaroo         52.00         3,035.00         1,742.00         2,368.00         12,208.00         12,909.00           KungFuMaster         258.50         22,736.50         26,846.00         12,006.00         33,378.00         31,025.00           MontezumaRevenge         0.00         4,753.30         0.00         3.00         0.00         0.00           MsPacman         307.30         6,951.60         36,742.0         2,450.70         4,699.00         3,884.40           NameThisGame         2,292.30         8,049.00         13,229.10         6,027.80         13,454.00         14,031.30           Phoenix         761.40         7,242.60         37,263.70         6,366.20         26,154.00         42,664.00			'				'
Hero   1,027.00   30,826.40   37,725.55   32,568.50   43,065.95   41,509.05   1ceHockey   -11.20   0.90   -1.90   -1.98   2.13   0.34				· ·	1 '	·	l '
IceHockey   -11.20   0.90   -1.90   -1.98   2.13   0.34     Jamesbond   29.00   302.80   642.50   4,913.50   961.00   1,512.00     JourneyEscape   NA				· ·			
Jamesbond         29.00         302.80         642.50         4,913.50         961.00         1,512.00           JourneyEscape         NA         NA         -607.00         -339.00         -840.00         -680.00           Kangaroo         52.00         3,035.00         1,742.00         2,368.00         12,208.00         12,909.00           Krull         1,598.00         2,665.50         9,695.51         8,643.09         9,514.03         9,127.63           KungFuMaster         258.50         22,736.50         26,846.00         12,006.00         33,378.00         31,025.00           MontezumaRevenge         0.00         4,753.30         0.00         3.00         0.00         0.00           MsPacman         307.30         6,951.60         3,674.20         2,450.70         4,699.00         3,884.40           NameThisGame         22,92.30         8,049.00         13,229.10         6,027.80         13,454.00         14,031.30           Phoenix         761.40         7,242.60         37,263.70         6,366.20         26,154.00         14,664.00           Pitfall         -229.40         6,463.70         0.00         0.00         -18.86         -3.36           Pong         -2.070         14.60		l '					
JourneyEscape   NA   NA   -607.00   -339.00   -840.00   -680.00	•						
Kangaroo         52.00         3,035.00         1,742.00         2,368.00         12,208.00         12,909.00           Krull         1,598.00         2,665.50         9,605.51         8,643.09         9,514.03         9,127.63           KungFuMaster         258.50         22,736.50         26,846.00         12,006.00         33,378.00         31,025.00           MontezumaRevenge         0.00         4,753.30         0.00         3.00         0.00         0.00           MsPacman         307.30         6,951.60         3,674.20         2,450.70         4,699.00         3,884.40           Phoenix         761.40         7,242.60         37,263.70         6,366.20         26,154.00         42,664.00           Pitfall         -229.40         6,463.70         0.00         0.00         -18.86         -3.36           Pong         -20.70         14.60         20.87         20.68         20.88         20.97           PrivateEye         24.90         69,571.30         100.00         71.51         196.30         100.00           Qbert         163.90         13,455.00         25,519.25         11,728.25         21,599.50         23,176.25           Riverraid         1,338.50         17,118.00					1 '		
Krull KungFuMaster         1,598.00         2,665.50         9,605.51         8,643.09         9,514.03         9,127.63           MontezumaRevenge MontezumaRevenge         0.00         4,753.30         0.00         3.00         0.00         0.00           MsPacman NameThisGame         307.30         6,951.60         3,674.20         2,450.70         4,699.00         3,884.40           Phoenix Pitfall         761.40         7,242.60         37,263.70         6,366.20         26,154.00         42,664.00           Pitfall         -229.40         6,463.70         0.00         0.00         -18.86         -3.36           Pong         -20.70         14.60         20.87         20.68         20.88         20.97           Pooyan Poyan         NA         NA         4,018.95         1,819.85         3,674.70         4,178.65           PrivateEye         24.90         69,571.30         100.00         71.51         196.30         100.00           Qbert         163.90         13,455.00         25,519.25         11,728.25         21,599.50         23,176.25           Riverraid         1,338.50         17,118.00         15,983.00         10,840.80         18,073.40         19,761.30           RoadRunner <t< td=""><td>• 1</td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	• 1						
MontezumaRevenge MsPacman         0.00 307.30         4,753.30 6,951.60         0.00 3,674.20         3.00 2,450.70         0.00 4,699.00         3,884.40           NameThisGame Phoenix         761.40 7,242.60         7,242.60 37,263.70         6,366.20 6,366.20         26,154.00 26,154.00         42,664.00 42,664.00           Pitfall Pong         -229.40 -20.70         6,463.70 14.60         0.00 20.87         20.68 20.88         20.88 20.88         20.97           Pooyan Pooyan Pooyan         NA NA NA 4,018.95         1,819.85 1,819.85         3,674.70 3,674.70         4,178.65 4,178.65           PrivateEye Qbert         24.90 163.90         69,571.30 13,455.00         100.00 25,519.25         11,728.25 11,728.25         21,599.50 23,176.25         23,176.25           Riverraid         1,338.50 11,338.50         17,118.00 15,983.00         10,840.80 168,200         18,073.40 19,761.30         19,761.30 68,272.00           Robotank         2.20 11.90         23.45 23,455.80         60.79 36.69         36.69 45.82         45.82           Seaquest Solaris         68.40 1,236.30         42,054.70 1,832.00         2,704.40 2,342.60         1,814.60 2,99.71.02         2,99.75.52           SpaceInvaders         148.00 1668.70         1,668.70 2,544.10         2,544.10 1,177.65         2,10.90 2,2228.30         2,228.30 2,228.30           StarGunner<				· ·		·	l '
MsPacman NameThisGame         307.30 2,292.30         6,951.60 8,049.00         3,674.20 13,229.10         2,450.70 6,027.80         4,699.00 13,454.00         3,884.40           Phoenix Phoenix         761.40         7,242.60         37,263.70         6,366.20         26,154.00         42,664.00           Pitfall Pong         -229.40         6,463.70         0.00         0.00         -18.86         -3.36           Pong Pooyan         NA         NA         4,018.95         1,819.85         3,674.70         4,178.65           PrivateEye Qt.490         69,571.30         100.00         71.51         196.30         100.00           Qbert Riverraid         163.90         13,455.00         25,519.25         11,728.25         21,599.50         23,176.25           Riverraid         1,338.50         17,118.00         15,983.00         10,840.80         18,073.40         19,761.30           Robotank         2.20         11.90         23.45         60.79         36.69         45.82           Seaquest Solaris         68.40         42,054.70         1,832.00         2,704.40         1,814.60         1,838.40           SpaceInvaders         148.00         1,668.70         2,452.80         2,342.60         2,204.80         2,579.20 <t< td=""><td>KungFuMaster</td><td>258.50</td><td>22,736.50</td><td>26,846.00</td><td>12,006.00</td><td>33,378.00</td><td>31,025.00</td></t<>	KungFuMaster	258.50	22,736.50	26,846.00	12,006.00	33,378.00	31,025.00
NameThisGame         2,292.30         8,049.00         13,229.10         6,027.80         13,454.00         14,031.30           Phoenix         761.40         7,242.60         37,263.70         6,366.20         26,154.00         42,664.00           Pitfall         -229.40         6,463.70         0.00         0.00         -18.86         -3.36           Pong         -20.70         14.60         20.87         20.68         20.88         20.97           Pooyan         NA         NA         4,018.95         1,819.85         3,674.70         4,178.65           PrivateEye         24.90         69,571.30         100.00         71.51         196.30         100.00           Qbert         163.90         13,455.00         25,519.25         11,728.25         21,599.50         23,176.25           Riverraid         1,338.50         17,118.00         15,983.00         10,840.80         18,073.40         19,761.30           Robotank         2.20         11.90         23.45         60.79         36.69         45.82           Seaquest         68.40         42,054.70         1,832.00         2,704.40         1,814.60         1,838.40           Skiing         -17,098.10         -4,336.90         -	MontezumaRevenge	0.00	4,753.30	0.00	3.00	0.00	0.00
Phoenix         761.40         7,242.60         37,263.70         6,366.20         26,154.00         42,664.00           Pitfall         -229.40         6,463.70         0.00         0.00         -18.86         -3.36           Pong         -20.70         14.60         20.87         20.68         20.88         20.97           Pooyan         NA         NA         4,018.95         1,819.85         3,674.70         4,178.65           PrivateEye         24.90         69,571.30         100.00         71.51         196.30         100.00           Qbert         163.90         13,455.00         25,519.25         11,728.25         21,599.50         23,176.25           Riverraid         1,338.50         17,118.00         15,983.00         10,840.80         18,073.40         19,761.30           RoadRunner         11.50         7,845.00         56,321.00         44,685.00         56,121.00         68,272.00           Robotank         2.20         11.90         23.45         60.79         36.69         45.82           Seaquest         68.40         42,054.70         1,832.00         2,704.40         1,814.60         1,838.40           Skiing         -17,098.10         -4,336.90         -7,95	MsPacman	307.30	6,951.60	3,674.20	2,450.70	4,699.00	3,884.40
Pitfall         -229.40         6,463.70         0.00         0.00         -18.86         -3.36           Pong         -20.70         14.60         20.87         20.68         20.88         20.97           Pooyan         NA         NA         4,018.95         1,819.85         3,674.70         4,178.65           PrivateEye         24.90         69,571.30         100.00         71.51         196.30         100.00           Qbert         163.90         13,455.00         25,519.25         11,728.25         21,599.50         23,176.25           Riverraid         1,338.50         17,118.00         15,983.00         10,840.80         18,073.40         19,761.30           RoadRunner         11.50         7,845.00         56,321.00         44,685.00         56,121.00         68,272.00           Robotank         2.20         11.90         23.45         60.79         36.69         45.82           Seaquest         68.40         42,054.70         1,832.00         2,704.40         1,814.60         1,838.40           Skiing         -17,098.10         -4,336.90         -7,958.81         -8,987.12         -29,971.02         -29,975.52           Solaris         1,236.30         12,326.70 <td< td=""><td>NameThisGame</td><td>2,292.30</td><td>8,049.00</td><td>13,229.10</td><td>6,027.80</td><td>13,454.00</td><td>14,031.30</td></td<>	NameThisGame	2,292.30	8,049.00	13,229.10	6,027.80	13,454.00	14,031.30
Pong Pooyan         -20.70 NA         14.60 NA         20.87 4,018.95         20.68 1,819.85         20.88 3,674.70         20.97           Proyan Pooyan PrivateEye PrivateEye PrivateEye 24.90         69,571.30 100.00         100.00 71.51 196.30         100.00         100.00         71.51 196.30         100.00         100.00         23,176.25         23,176.25         23,176.25         23,176.25         23,176.25         23,176.25         23,176.25         23,176.25         11,728.25         21,599.50         23,176.25         23,176.25         23,176.25         11,728.25         21,599.50         23,176.25         23,176.25         21,599.50         23,176.25         23,176.25         21,599.50         23,176.25         24,176.00         23,176.25         24,176.30         <	Phoenix	761.40	7,242.60		1 '	26,154.00	42,664.00
Pooyan PrivateEye         NA 24,90         69,571.30 (9,571.30)         100.00 (10.00)         71.51 (196.30)         196.30 (100.00)           Qbert Qbert (163.90)         13,455.00         25,519.25 (11,728.25)         21,599.50 (23,176.25)         23,176.25           Riverraid RoadRunner (11.50)         7,845.00 (7,845.00)         56,321.00 (10,840.80)         18,073.40 (19,761.30)         19,761.30           Robotank (11.50)         7,845.00 (7,845.00)         56,321.00 (10,840.80)         36.69 (11.00)         68,272.00           Robotank (11.50)         2.20 (11.90)         23.45 (11.90)         60.79 (11.81.60)         36.69 (11.838.40)         45.82           Seaquest (11.50)         44,369.00 (11.832.00)         2,704.40 (1.814.60)         1,838.40         1,838.40         1,838.40         1,838.40         1,838.40         1,838.40         1,838.40         1,838.40         1,838.40         1,838.40         2,9971.02 (1.888.40)         2,9971.02 (1.888.40)         2,9975.52         2,9971.02 (1.888.40)         2,9975.52         2,342.60 (1.788.80)         2,410.90 (1.888.40)         2,579.20         2,579.20         2,579.20         2,579.20         2,579.20         2,204.80 (1.768.20)         2,779.20         2,228.30         2,410.90 (1.488.00)         2,228.30         2,410.90 (1.488.00)         2,759.20         2,228.30         2,410.90 (1.498.00) <td< td=""><td></td><td></td><td>/</td><td></td><td>0.00</td><td></td><td></td></td<>			/		0.00		
PrivateEye         24.90         69,571.30         100.00         71.51         196.30         100.00           Qbert         163.90         13,455.00         25,519.25         11,728.25         21,599.50         23,176.25           Riverraid         1,338.50         17,118.00         15,983.00         10,840.80         18,073.40         19,761.30           RoadRunner         11.50         7,845.00         56,321.00         44,685.00         56,121.00         68,272.00           Robotank         2.20         11.90         23.45         60.79         36.69         45.82           Seaquest         68.40         42,054.70         1,832.00         2,704.40         1,814.60         1,838.40           Skiing         -17,098.10         -4,336.90         -7,958.81         -8,987.12         -29,971.02         -29,975.52           Solaris         1,236.30         12,326.70         2,452.80         2,342.60         2,204.80         2,579.20           SpaceInvaders         148.00         1,668.70         2,544.10         1,177.65         2,410.90         2,228.30           StarGunner         664.00         10,250.00         74,848.00         57,053.00         97,450.00         104,188.00           TimePilot	_						
Qbert         163.90         13,455.00         25,519.25         11,728.25         21,599.50         23,176.25           Riverraid         1,338.50         17,118.00         15,983.00         10,840.80         18,073.40         19,761.30           RoadRunner         11.50         7,845.00         56,321.00         44,685.00         56,121.00         68,272.00           Robotank         2.20         11.90         23.45         60.79         36.69         45.82           Seaquest         68.40         42,054.70         1,832.00         2,704.40         1,814.60         1,838.40           Skiing         -17,098.10         -4,336.90         -7,958.81         -8,987.12         -29,971.02         -29,975.52           Solaris         1,236.30         12,326.70         2,452.80         2,342.60         2,204.80         2,579.20           SpaceInvaders         148.00         1,668.70         2,544.10         1,177.65         2,410.90         2,228.30           StarGunner         664.00         10,250.00         74,848.00         57,053.00         97,450.00         104,188.00           Tennis         -23.80         -8.30         -8.16         -6.17         -7.54         -5.90           Tutankham         1							
Riverraid         1,338.50         17,118.00         15,983.00         10,840.80         18,073.40         19,761.30           RoadRunner         11.50         7,845.00         56,321.00         44,685.00         56,121.00         68,272.00           Robotank         2.20         11.90         23.45         60.79         36.69         45.82           Seaquest         68.40         42,054.70         1,832.00         2,704.40         1,814.60         1,838.40           Skiing         -17,098.10         -4,336.90         -7,958.81         -8,987.12         -29,971.02         -29,975.52           Solaris         1,236.30         12,326.70         2,452.80         2,342.60         2,204.80         2,579.20           SpaceInvaders         148.00         1,668.70         2,544.10         1,177.65         2,410.90         2,228.30           StarGunner         664.00         10,250.00         74,848.00         57,053.00         97,450.00         104,188.00           Tennis         -23.80         -8.30         -8.16         -6.17         -7.54         -5.90           TimePilot         3,568.00         5,229.20         12,157.00         14,746.00         11,704.00         13,227.00           Tutankham	•		1 1				
RoadRunner         11.50         7,845.00         56,321.00         44,685.00         56,121.00         68,272.00           Robotank         2.20         11.90         23.45         60.79         36.69         45.82           Seaquest         68.40         42,054.70         1,832.00         2,704.40         1,814.60         1,838.40           Skiing         -17,098.10         -4,336.90         -7,958.81         -8,987.12         -29,971.02         -29,975.52           Solaris         1,236.30         12,326.70         2,452.80         2,342.60         2,204.80         2,579.20           SpaceInvaders         148.00         1,668.70         2,544.10         1,177.65         2,410.90         2,228.30           StarGunner         664.00         10,250.00         74,848.00         57,053.00         97,450.00         104,188.00           Tennis         -23.80         -8.30         -8.16         -6.17         -7.54         -5.90           TimePilot         3,568.00         5,229.20         12,157.00         14,746.00         11,704.00         13,227.00           Tutankham         11,40         167.60         206.32         210.66         208.72         209.82           UpNDown         533.40							
Robotank         2.20         11.90         23.45         60.79         36.69         45.82           Seaquest         68.40         42,054.70         1,832.00         2,704.40         1,814.60         1,838.40           Skiing         -17,098.10         -4,336.90         -7,958.81         -8,987.12         -29,971.02         -29,975.52           Solaris         1,236.30         12,326.70         2,452.80         2,342.60         2,204.80         2,579.20           SpaceInvaders         148.00         1,668.70         2,544.10         1,177.65         2,410.90         2,228.30           StarGunner         664.00         10,250.00         74,848.00         57,053.00         97,450.00         104,188.00           Tennis         -23.80         -8.30         -8.16         -6.17         -7.54         -5.90           TimePilot         3,568.00         5,229.20         12,157.00         14,746.00         11,704.00         13,227.00           Tutankham         11,40         167.60         206.32         210.66         208.72         209.82           UpNDown         533.40         11,893.20         158,629.50         84,962.70         161,328.40         129,243.70           Venture         0.00			1				
Seaquest         68.40         42,054.70         1,832.00         2,704.40         1,814.60         1,838.40           Skiing         -17,098.10         -4,336.90         -7,958.81         -8,987.12         -29,971.02         -29,975.52           Solaris         1,236.30         12,326.70         2,452.80         2,342.60         2,204.80         2,579.20           SpaceInvaders         148.00         1,668.70         2,544.10         1,177.65         2,410.90         2,228.30           StarGunner         664.00         10,250.00         74,848.00         57,053.00         97,450.00         104,188.00           Tennis         -23.80         -8.30         -8.16         -6.17         -7.54         -5.90           TimePilot         3,568.00         5,229.20         12,157.00         14,746.00         11,704.00         13,227.00           Tutankham         11,40         167.60         206.32         210.66         208.72         209.82           UpNDown         533.40         11,693.20         158,629.50         84,962.70         161,328.40         129,243.70           Venture         0.00         1,187.50         0.00         0.00         1,339.00         1,181.00           VideoPinball         16,							
Skiing         -17,098.10         -4,336.90         -7,958.81         -8,987.12         -29,971.02         -29,975.52           Solaris         1,236.30         12,326.70         2,452.80         2,342.60         2,204.80         2,579.20           SpaceInvaders         148.00         1,668.70         2,544.10         1,177.65         2,410.90         2,228.30           StarGunner         664.00         10,250.00         74,848.00         57,053.00         97,450.00         104,188.00           Tennis         -23.80         -8.30         -8.16         -6.17         -7.54         -5.90           TimePilot         3,568.00         5,229.20         12,157.00         14,746.00         11,704.00         13,227.00           Tutankham         11,40         167.60         206.32         210.66         208.72         209.82           UpNDown         533.40         11,693.20         158,629.50         84,962.70         161,328.40         129,243.70           Venture         0.00         1,187.50         0.00         0.00         1,339.00         1,181.00           VideoPinball         16,256.90         17,667.90         279,504.81         55,113.30         59,988.90         55,272.82           WizardOfWar			1				
Solaris         1,236.30         12,326.70         2,452.80         2,342.60         2,204.80         2,579.20           SpaceInvaders         148.00         1,668.70         2,544.10         1,177.65         2,410.90         2,228.30           StarGunner         664.00         10,250.00         74,848.00         57,053.00         97,450.00         104,188.00           Tennis         -23.80         -8.30         -8.16         -6.17         -7.54         -5.90           TimePilot         3,568.00         5,229.20         12,157.00         14,746.00         11,704.00         13,227.00           Tutankham         11,40         167.60         206.32         210.66         208.72         209.82           UpNDown         533.40         11,693.20         158,629.50         84,962.70         161,328.40         129,243.70           Venture         0.00         1,187.50         0.00         0.00         1,339.00         1,181.00           VideoPinball         16,256.90         17,667.90         279,504.81         55,113.30         59,988.90         55,272.82           WizardOfWar         563.50         4,756.50         8,749.00         5,688.00         9,165.00         11,388.00           YarsRevenge				· ·			
SpaceInvaders         148.00         1,668.70         2,544.10         1,177.65         2,410.90         2,228.30           StarGunner         664.00         10,250.00         74,848.00         57,053.00         97,450.00         104,188.00           Tennis         -23.80         -8.30         -8.16         -6.17         -7.54         -5.90           TimePilot         3,568.00         5,229.20         12,157.00         14,746.00         11,704.00         13,227.00           Tutankham         11,40         167.60         206.32         210.66         208.72         209.82           UpNDown         533.40         11,693.20         158,629.50         84,962.70         161,328.40         129,243.70           Venture         0.00         1,187.50         0.00         0.00         1,339.00         1,181.00           VideoPinball         16,256.90         17,667.90         279,504.81         55,113.30         59,988.90         55,272.82           WizardOfWar         563.50         4,756.50         8,749.00         5,688.00         9,165.00         11,388.00           YarsRevenge         3,092.90         54,576.90         92,709.94         83,136.68         100,082.55         103,895.05	_		· '				
StarGunner         664.00         10,250.00         74,848.00         57,053.00         97,450.00         104,188.00           Tennis         -23.80         -8.30         -8.16         -6.17         -7.54         -5.90           TimePilot         3,568.00         5,229.20         12,157.00         14,746.00         11,704.00         13,227.00           Tutankham         11,40         167.60         206.32         210.66         208.72         209.82           UpNDown         533.40         11,693.20         158,629.50         84,962.70         161,328.40         129,243.70           Venture         0.00         1,187.50         0.00         0.00         1,339.00         1,181.00           VideoPinball         16,256.90         17,667.90         279,504.81         55,113.30         59,988.90         55,272.82           WizardOfWar         563.50         4,756.50         8,749.00         5,688.00         9,165.00         11,388.00           YarsRevenge         3,092.90         54,576.90         92,709.94         83,136.68         100,082.55         103,895.05		l '					
Tennis         -23.80         -8.30         -8.16         -6.17         -7.54         -5.90           TimePilot         3,568.00         5,229.20         12,157.00         14,746.00         11,704.00         13,227.00           Tutankham         11,40         167.60         206.32         210.66         208.72         209.82           UpNDown         533.40         11,693.20         158,629.50         84,962.70         161,328.40         129,243.70           Venture         0.00         1,187.50         0.00         0.00         1,339.00         1,181.00           VideoPinball         16,256.90         17,667.90         279,504.81         55,113.30         59,988.90         55,272.82           WizardOfWar         563.50         4,756.50         8,749.00         5,688.00         9,165.00         11,388.00           YarsRevenge         3,092.90         54,576.90         92,709.94         83,136.68         100,082.55         103,895.05				· /			
TimePilot         3,568.00         5,229.20         12,157.00         14,746.00         11,704.00         13,227.00           Tutankham         11,40         167.60         206.32         210.66         208.72         209.82           UpNDown         533.40         11,693.20         158,629.50         84,962.70         161,328.40         129,243.70           Venture         0.00         1,187.50         0.00         0.00         1,339.00         1,181.00           VideoPinball         16,256.90         17,667.90         279,504.81         55,113.30         59,988.90         55,272.82           WizardOfWar         563.50         4,756.50         8,749.00         5,688.00         9,165.00         11,388.00           YarsRevenge         3,092.90         54,576.90         92,709.94         83,136.68         100,082.55         103,895.05			1				
Tutankham         11,40         167.60         206.32         210.66         208.72         209.82           UpNDown         533.40         11,693.20         158,629.50         84,962.70         161,328.40         129,243.70           Venture         0.00         1,187.50         0.00         0.00         1,339.00         1,181.00           VideoPinball         16,256.90         17,667.90         279,504.81         55,113.30         59,988.90         55,272.82           WizardOfWar         563.50         4,756.50         8,749.00         5,688.00         9,165.00         11,388.00           YarsRevenge         3,092.90         54,576.90         92,709.94         83,136.68         100,082.55         103,895.05							
UpNDown         533.40         11,693.20         158,629.50         84,962.70         161,328.40         129,243.70           Venture         0.00         1,187.50         0.00         0.00         1,339.00         1,181.00           VideoPinball         16,256.90         17,667.90         279,504.81         55,113.30         59,988.90         55,272.82           WizardOfWar         563.50         4,756.50         8,749.00         5,688.00         9,165.00         11,388.00           YarsRevenge         3,092.90         54,576.90         92,709.94         83,136.68         100,082.55         103,895.05					1 '	·	
Venture         0.00         1,187.50         0.00         0.00         1,339.00         1,181.00           VideoPinball         16,256.90         17,667.90         279,504.81         55,113.30         59,988.90         55,272.82           WizardOfWar         563.50         4,756.50         8,749.00         5,688.00         9,165.00         11,388.00           YarsRevenge         3,092.90         54,576.90         92,709.94         83,136.68         100,082.55         103,895.05							
VideoPinball         16,256.90         17,667.90         279,504.81         55,113.30         59,988.90         55,272.82           WizardOfWar         563.50         4,756.50         8,749.00         5,688.00         9,165.00         11,388.00           YarsRevenge         3,092.90         54,576.90         92,709.94         83,136.68         100,082.55         103,895.05			1		1 '		
WizardOfWar YarsRevenge         563.50         4,756.50         8,749.00         5,688.00         9,165.00         11,388.00           92,709.94         83,136.68         100,082.55         103,895.05							
YarsRevenge 3,092.90 54,576.90 92,709.94 83,136.68 100,082.55 <b>103,895.05</b>				·			
	Zaxxon	32.50	9,173.00	13,336.00	11,886.00	14,882.00	18,436.00