Game AI
(for Economists)

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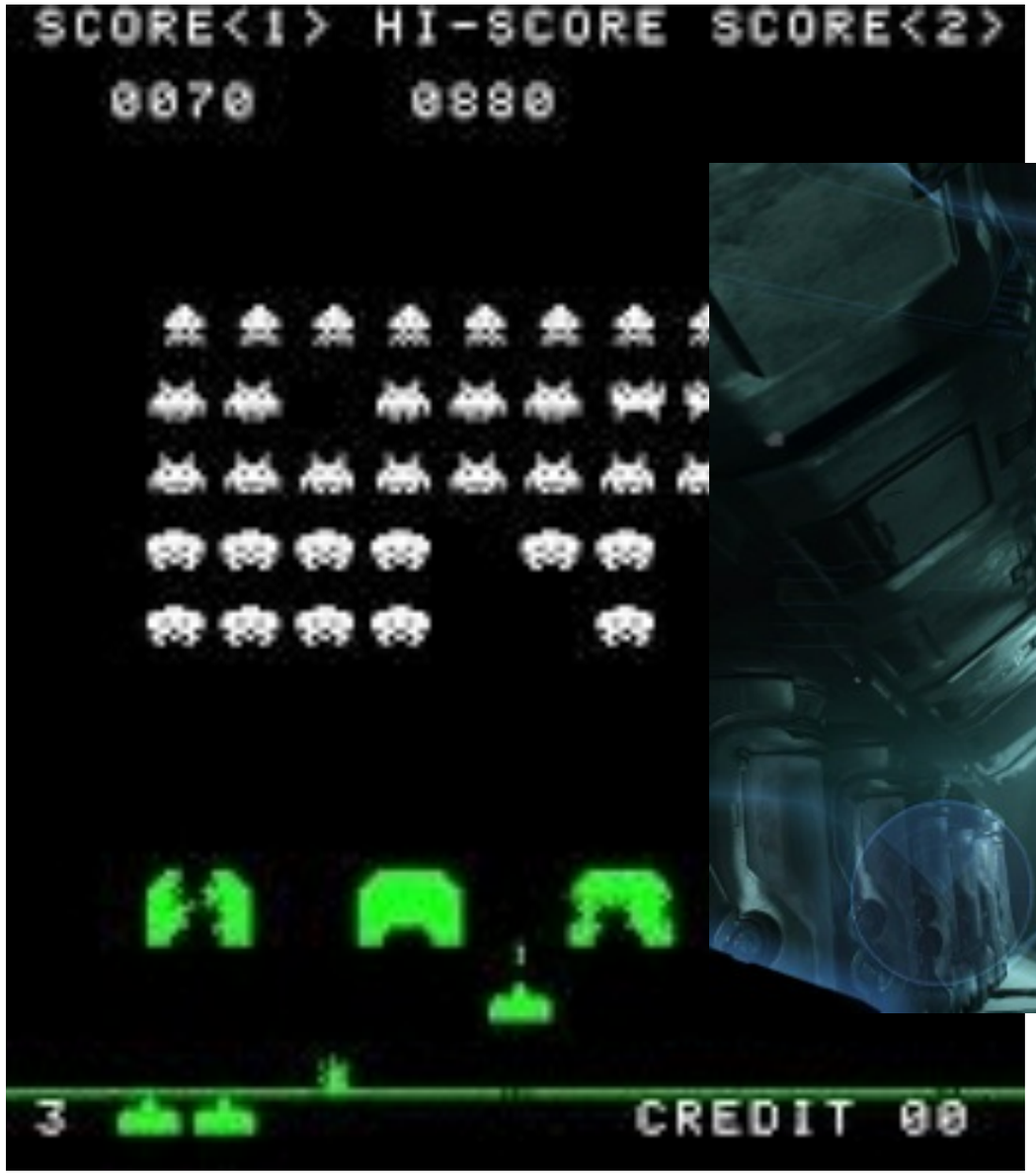
Who am I?

- Malmöit
- Studied in Lund, Sussex, Essex
- Postdoc in Lugano, at ITU for 4.5 years
- philosophy + psychology >> artificial intelligence + robotics >> games
- Current research focus: player modelling, procedural content generation, evolutionary computation

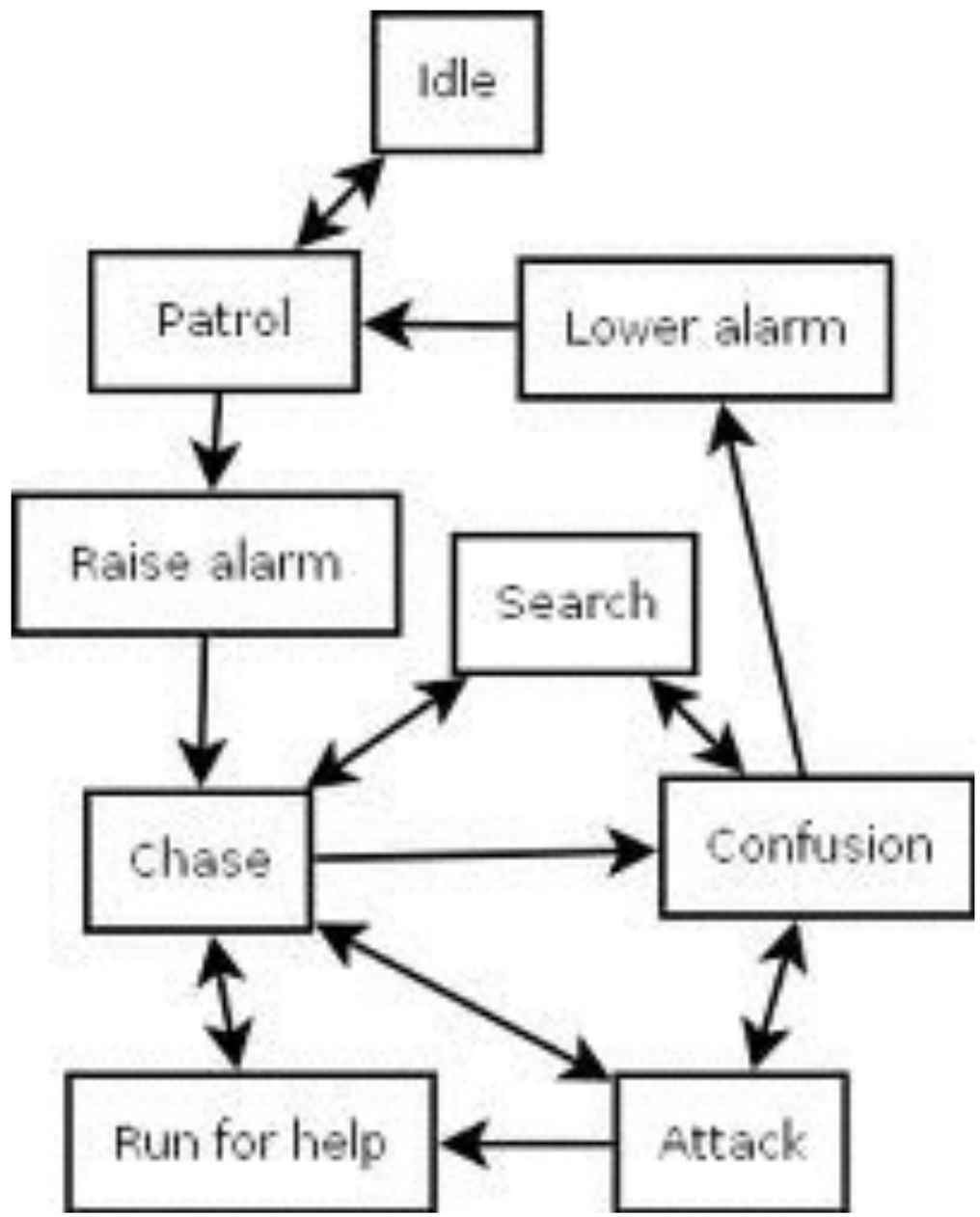
Games + AI = …

- Simple behaviour control for simple NPCs in commercial games
- Occasional more complex algorithms in commercial games, e.g. behaviour trees
- Tree-search algorithms for board games and “general game playing”
- Reinforcement learning and evolution
- Procedural content generation
- Player modelling

Twitch-based games



Finite state machines



A* search

7	6	5	6	7	8	9	10	11		19	20	21	22
6	5	4	5	6	7	8	9	10		18	19	20	21
5	4	3	4	5	6	7	8	9		17	18	19	20
4	3	2	3	4	5	6	7	8		16	17	18	19
3	2	1	2	3	4	5	6	7		15	16	17	18
2	1	0	1	2	3	4	5	6		14	15	16	17
3	2	1	2	3	4	5	6	7		13	14	15	16
4	3	2	3	4	5	6	7	8		12	13	14	15
5	4	3	4	5	6	7	8	9	10	11	12	13	14
6	5	4	5	6	7	8	9	10	11	12	13	14	15

STRIPS-like planning

Go ...

Go to object bx

GOTOB(bx)

Preconditions: TYPE(bx,OBJECT),(∃rx)[INROOM(bx,rx) ∧ INROOM(ROBOT,rx)]
Deletions: AT(ROBOT,$1,$2), NEXTTO(ROBOT,$1)
Additions: *NEXTTO(ROBOT,bx)

Go to door dx.

GOTOD(dx)

Preconditions: TYPE(dx,DOOR),(∃rx)(∃ry)[INROOM(ROBOT,rx) ∧ CONNECTS(dx,rx,ry)]
Deletions: AT(ROBOT,$1,$2), NEXTTO(ROBOT,$1)
Additions: *NEXTTO(ROBOT,dx)

Go to coordinate location (x,y).

GOTOL(x,y)

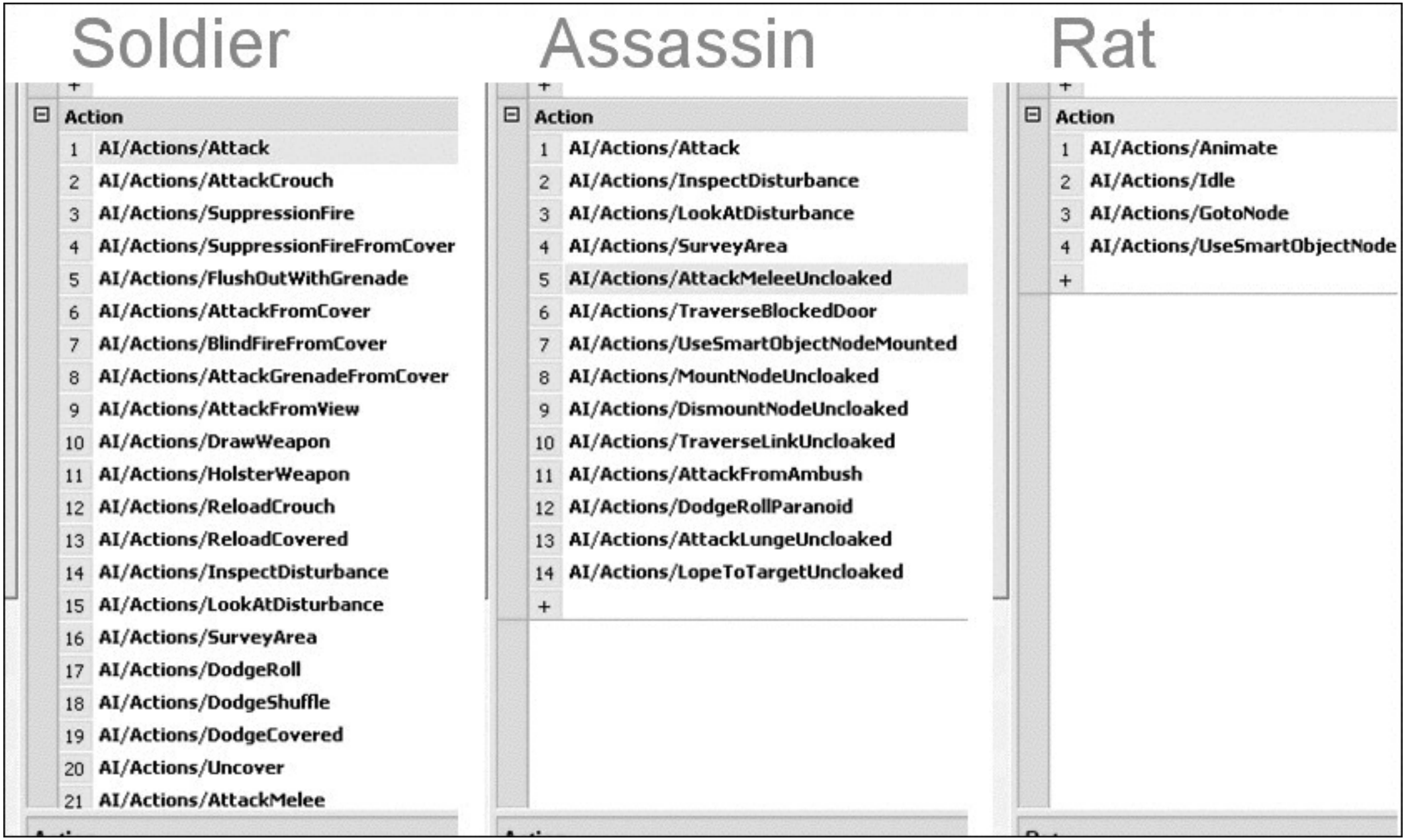
Preconditions: (∃rx)[INROOM(ROBOT,rx) ∧ LOCINROOM(x,y,rx)]
Deletions: AT(ROBOT,$1,$2), NEXTTO(ROBOT,$1)
Additions: *AT(ROBOT,x,y)

Go through door dx into room rx.

GOTHRUDR(dx,rx)

Preconditions: TYPE(dx,DOOR), STATUS(dx,OPEN), TYPE(rx,ROOM),
NEXTTO(ROBOT,dx) (∃rx)[INROOM(ROBOT,ry) ∧ CONNECTS(dx,ry,rx)]
Deletions: AT(ROBOT,$1,$2), NEXTTO(ROBOT$1), INROOM(ROBOT,$1)
Additions: *INROOM(ROBOT,rx)

STRIPS-like planning



Soldier

	Action
1	AI/Actions/Attack
2	AI/Actions/AttackCrouch
3	AI/Actions/SuppressionFire
4	AI/Actions/SuppressionFireFromCover
5	AI/Actions/FlushOutWithGrenade
6	AI/Actions/AttackFromCover
7	AI/Actions/BlindFireFromCover
8	AI/Actions/AttackGrenadeFromCover
9	AI/Actions/AttackFromView
10	AI/Actions/DrawWeapon
11	AI/Actions/HolsterWeapon
12	AI/Actions/ReloadCrouch
13	AI/Actions/ReloadCovered
14	AI/Actions/InspectDisturbance
15	AI/Actions/LookAtDisturbance
16	AI/Actions/SurveyArea
17	AI/Actions/DodgeRoll
18	AI/Actions/DodgeShuffle
19	AI/Actions/DodgeCovered
20	AI/Actions/Uncover
21	AI/Actions/AttackMelee

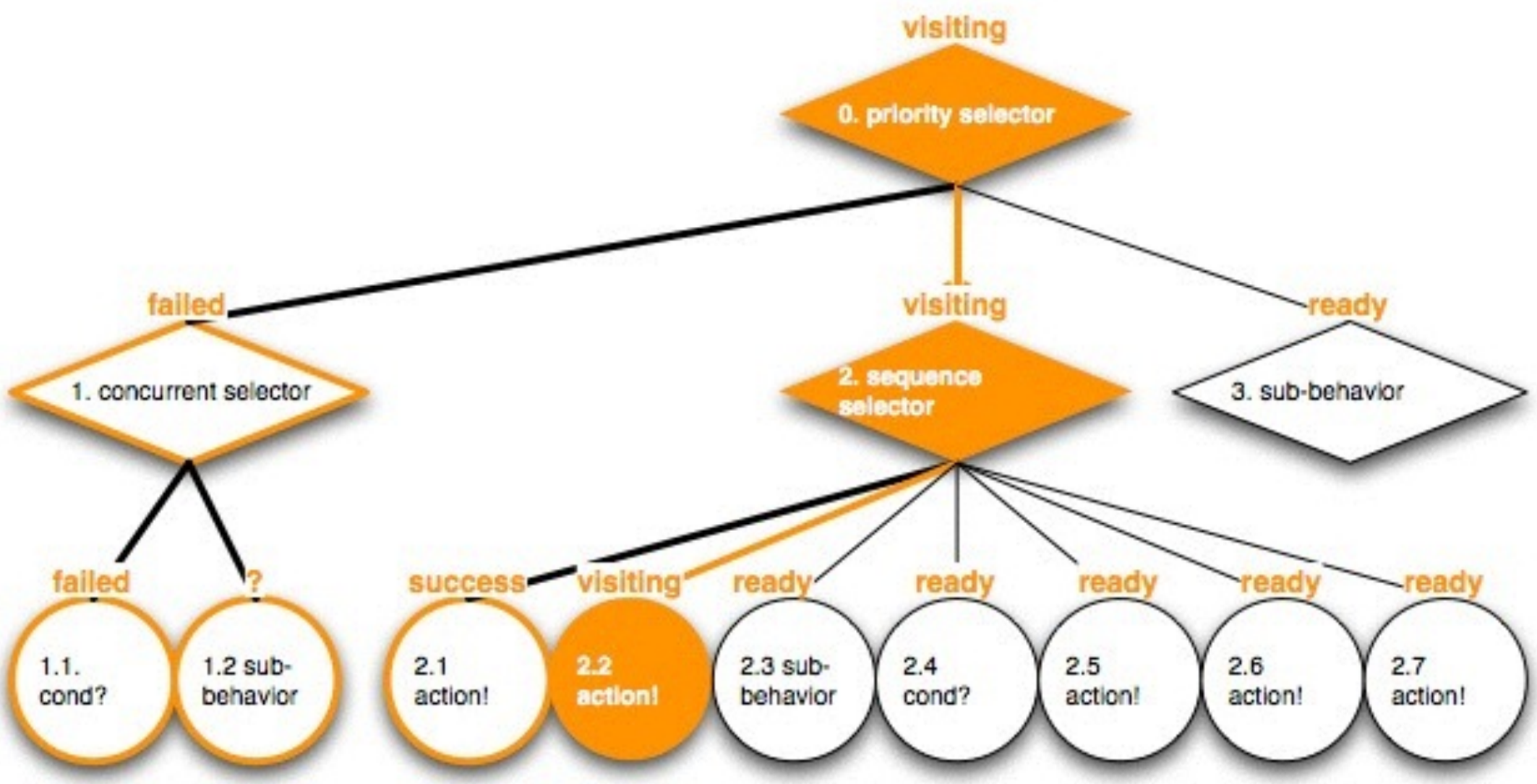
Assassin

	Action
1	AI/Actions/Attack
2	AI/Actions/InspectDisturbance
3	AI/Actions/LookAtDisturbance
4	AI/Actions/SurveyArea
5	AI/Actions/AttackMeleeUncloaked
6	AI/Actions/TraverseBlockedDoor
7	AI/Actions/UseSmartObjectNodeMounted
8	AI/Actions/MountNodeUncloaked
9	AI/Actions/DismountNodeUncloaked
10	AI/Actions/TraverseLinkUncloaked
11	AI/Actions/AttackFromAmbush
12	AI/Actions/DodgeRollParanoid
13	AI/Actions/AttackLungeUncloaked
14	AI/Actions/LopeToTargetUncloaked

Rat

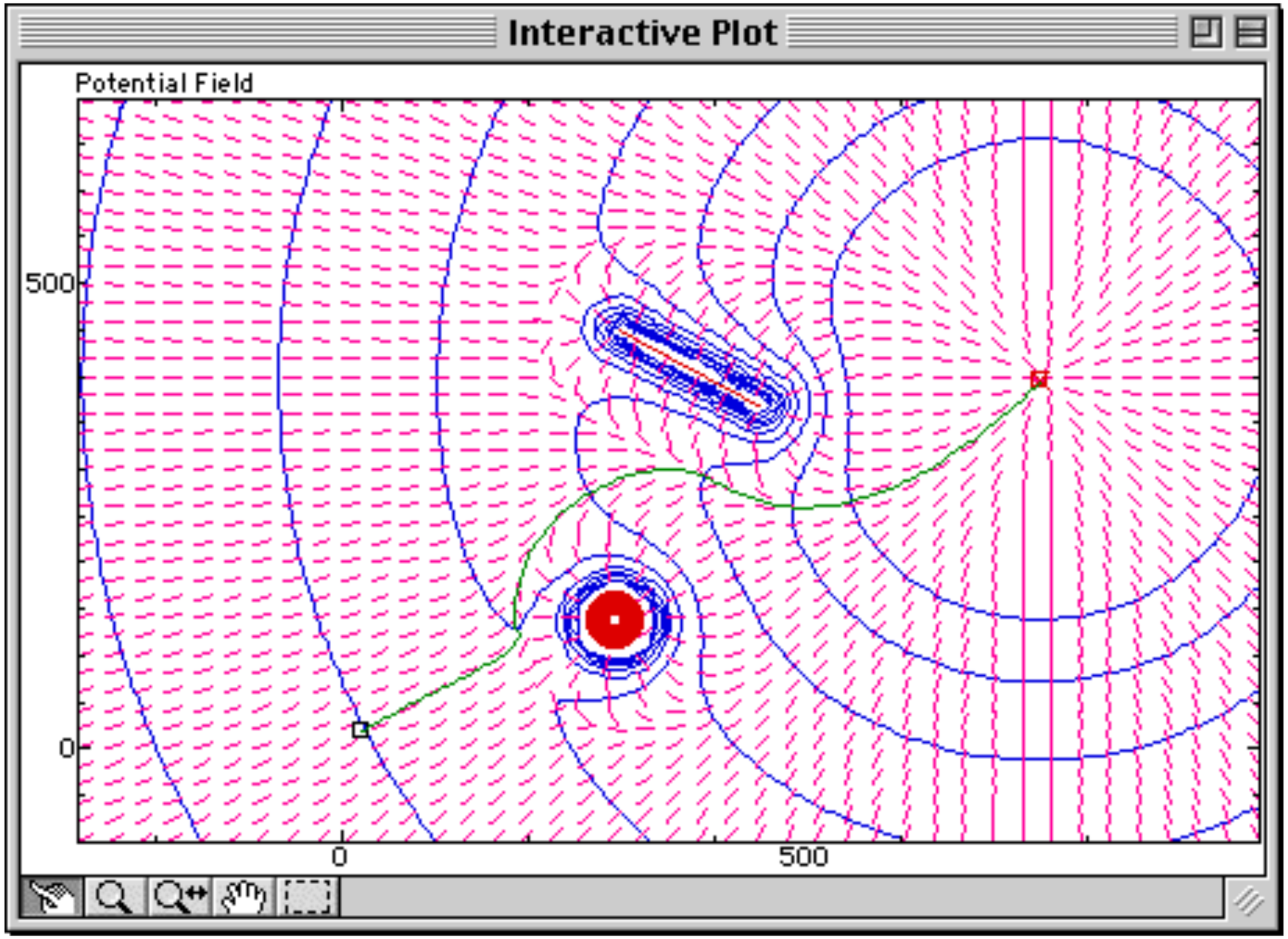
	Action
1	AI/Actions/Animate
2	AI/Actions/Idle
3	AI/Actions/GotoNode
4	AI/Actions/UseSmartObjectNode

Behaviour trees



Strategy games

Potential fields

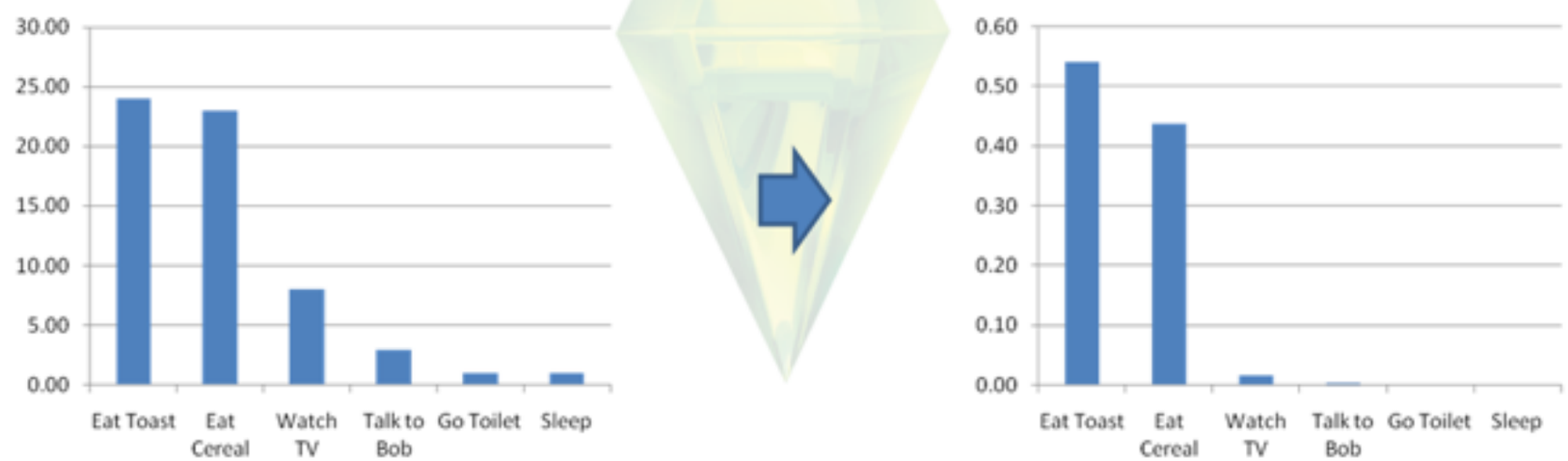


Social simulation games

Needs-based AI

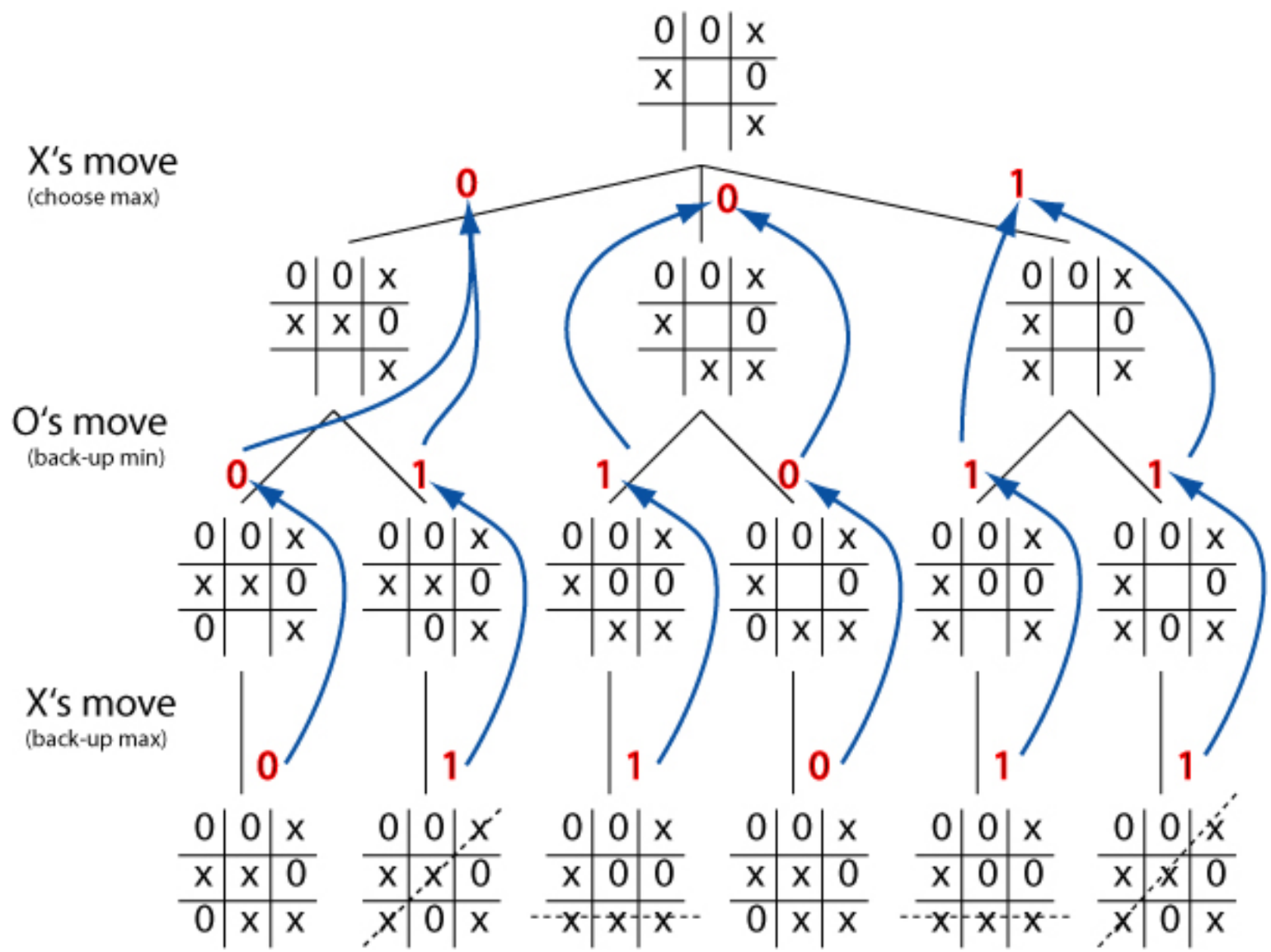
Different Ways of Deciding What To Do

- Always choose the highest-scoring action
- Choose randomly from one of the n highest-scoring actions
- Choose randomly using the score distribution as the probability distribution

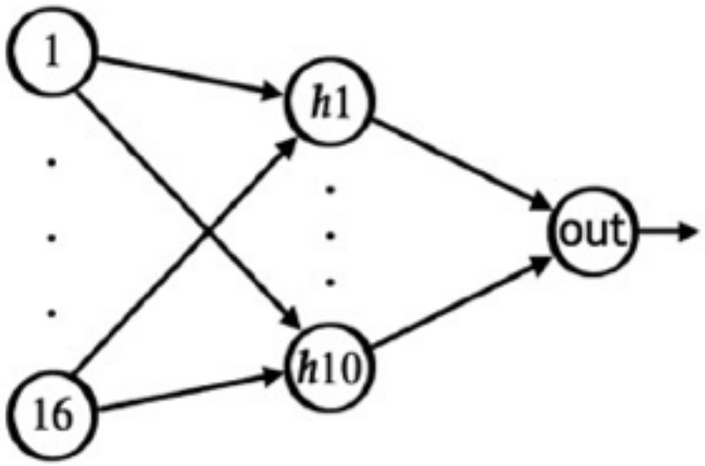


Board games

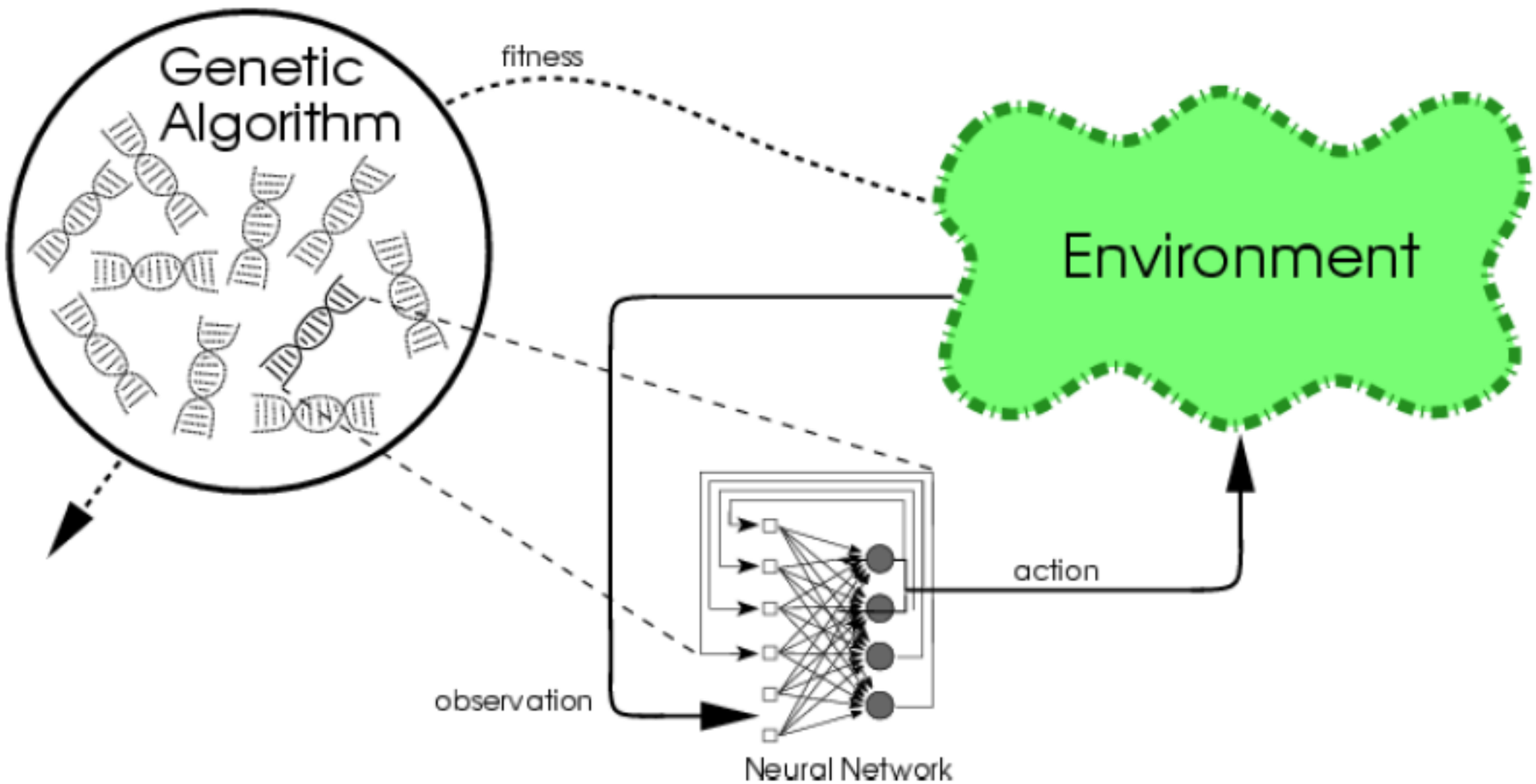
MiniMax



Evaluation function



Neuroevolution



Monte Carlo Tree Search

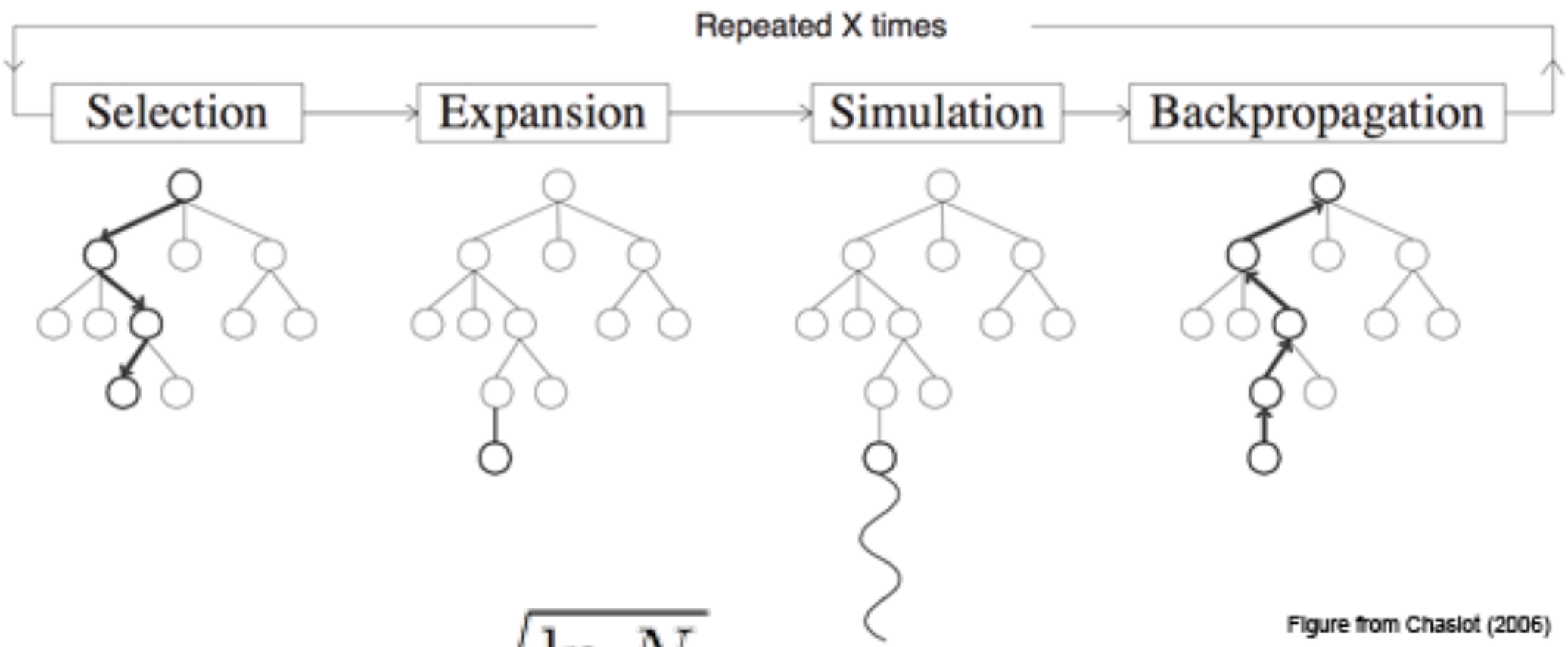


Figure from Chaslot (2006)

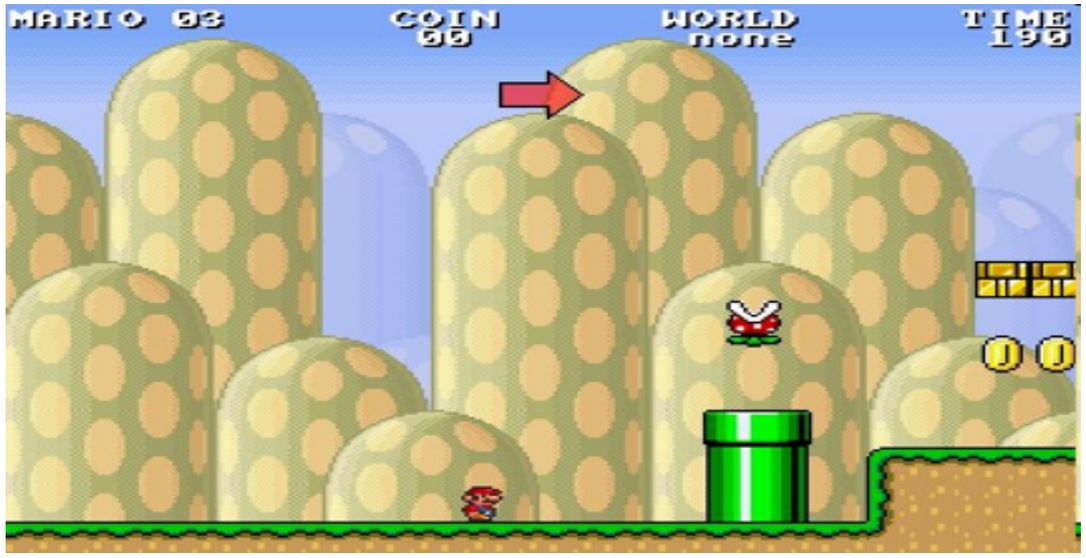
$$v_i + C \times \sqrt{\frac{\ln N}{n_i}}$$

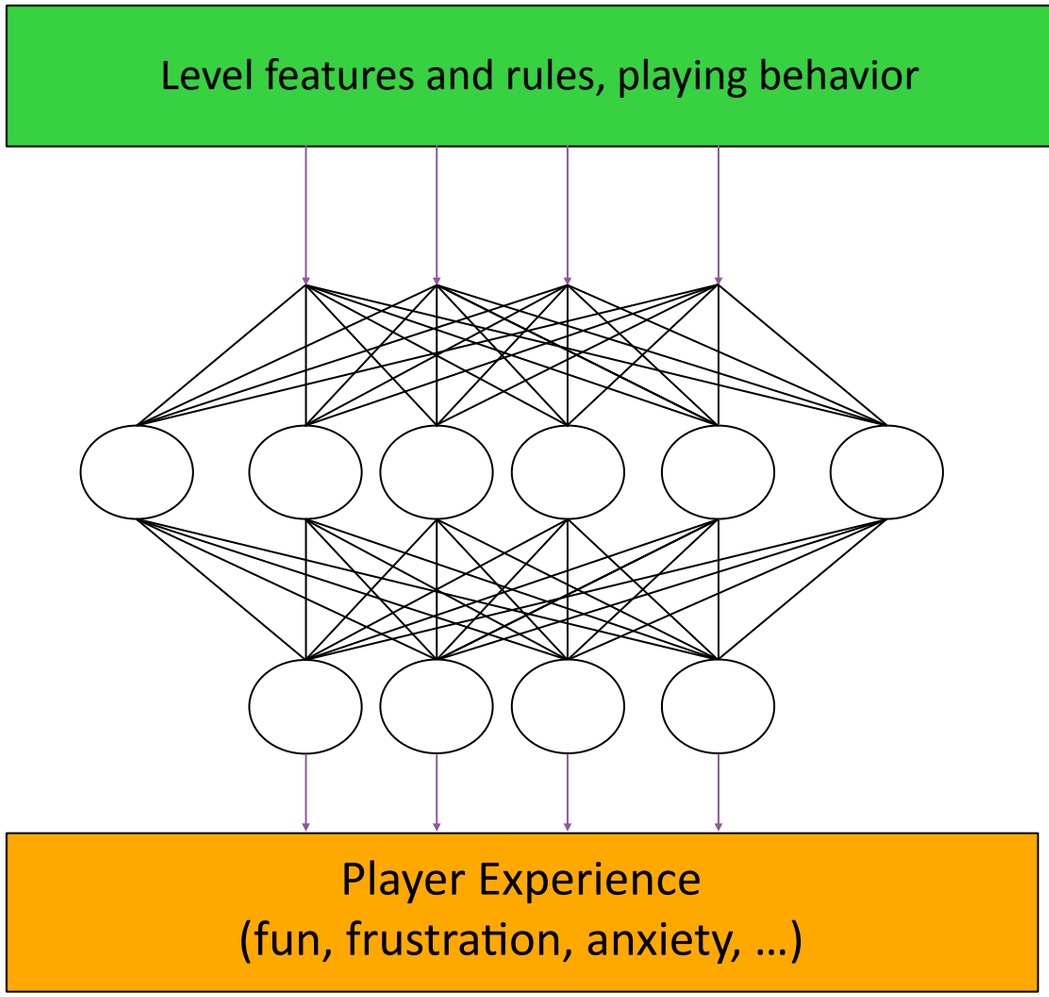
Player modelling

- Player preferences
- Player experience
- Player style (abstract)
- Player behaviour (detailed)

Player level preferences in Super Mario Bros

- Neuroevolutionary preference learning
- Player experience model 73-92%





C. Pedersen, J. Togelius, G. N. Yannakakis., Modeling Player Experience for Content Creation IEEE TCIAG, 2010

Procedural content generation in games