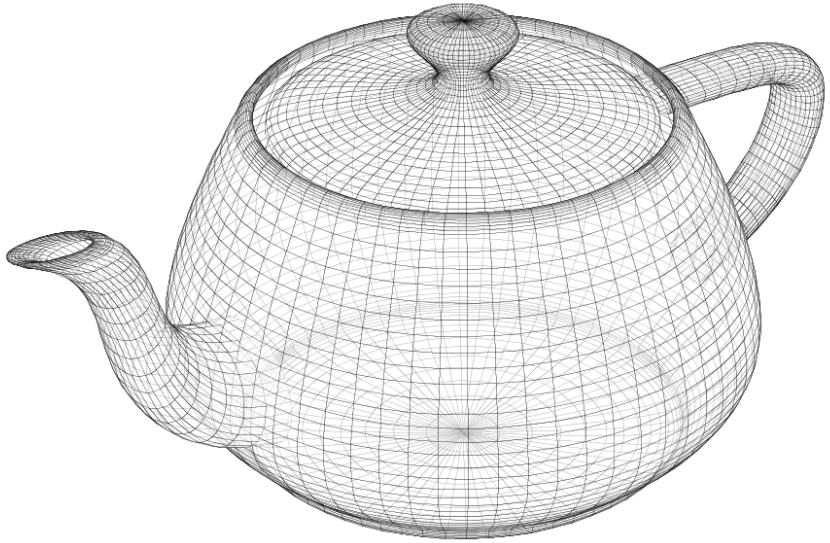


Game AI

Some History

Professor Eric Shaffer

What is AI?

- The term Artificial Intelligence was coined by John McCarthy in 1956
- “The science and engineering of making intelligent machines”

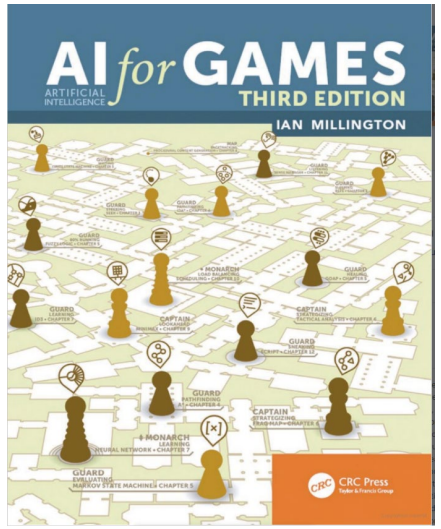
  …but there’s no agreed upon definition of intelligence

WHAT IS AI?

Artificial intelligence is about making computers able to perform the thinking tasks that humans and animals are capable of.

We can program computers to have superhuman abilities in solving many problems: arithmetic, sorting, searching, and so on. Some of these problems were originally considered AI problems, but as they have been solved in more and more comprehensive ways, they have slipped out of the domain of AI developers.

Millington, Ian. AI for Games, Third Edition



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Search and Knowledge

A common feature of symbolic systems is a trade-off: when solving a problem the more knowledge you have, the less work you need to do in reasoning. Often, reasoning algorithms consist of searching: trying different possibilities to get the best result. This leads us to the golden rule of AI, that we will see in various forms throughout this book:

> Search and knowledge are intrinsically linked. The more knowledge you have, the less searching for an answer you need; the more search you can do (i.e., the faster you can search), the less knowledge you need.

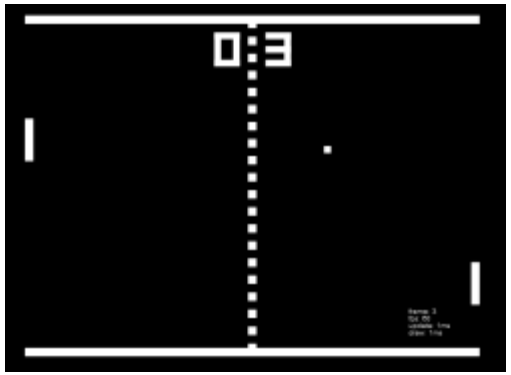
Millington, Ian. AI for Games, Third Edition

- Example of search…looking through a state space to find an action that moves the AI agent to an "optimal" state.

- Example of knowledge `IF injured THEN use health pack`

Pong!

Original 1972 version was multi-player only



Some subsequent spins sort of had AI…used a two part strategy:

Model reaction time

- wait some amount of time before moving paddle

Model accuracy

- the computer can compute exactly where the ball will land
- add a random error factor to pretend that the computer is fallible

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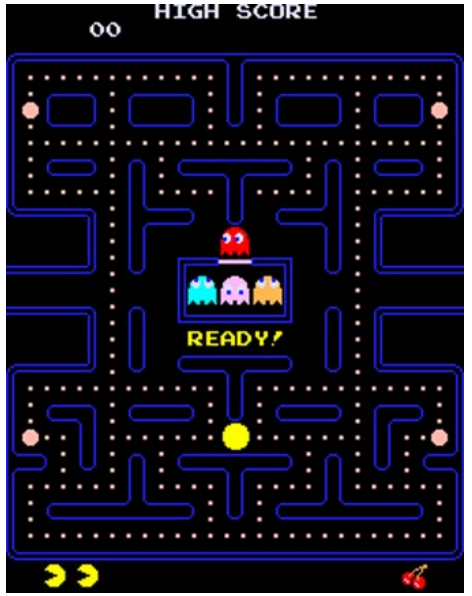
Pac-Man

Pac-Man was the first game many people remember playing with noticeable AI.



But Pac-Man had enemy characters that seemed to conspire against you.

May 22nd, 1980, released in arcades in Japan.

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Pac-Man

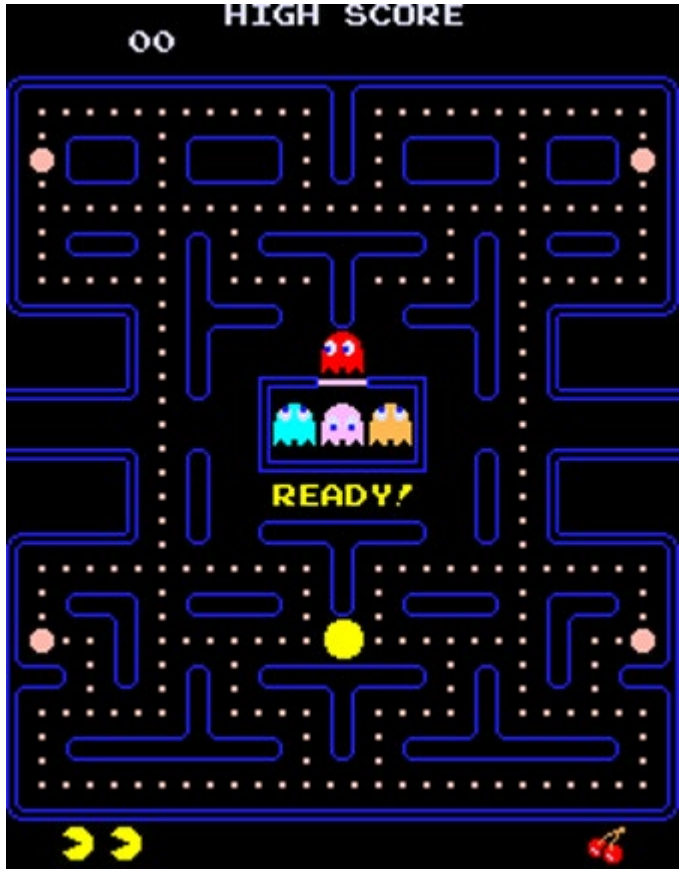
Pac-Man relied on a simple AI technique: a state machine

There are four monsters
(later called ghosts after a disastrously flickering port to the Atari 2600)

They are in one of three states:

- chase
- scatter
- frightened

For each state they choose a tile as their target,
and turn toward it at each junction



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The 3 States of Pac-Man

Ghosts alternate between scatter and chase modes during gameplay at predetermined intervals.

Ghosts are forced to reverse direction by the system anytime the mode changes from: chase-to-scatter, chase-to-frightened, scatter-to-chase, and scatter-to-frightened.

Ghosts do not reverse direction when changing back from frightened to chase or scatter modes.

Mode	Level 1	Levels 2–4	Levels 5+
Scatter	7	7	5
Chase	20	20	20
Scatter	7	7	5
Chase	20	20	20
Scatter	5	5	5
Chase	20	1033	1037
Scatter	5	1/60	1/60
Chase	indefinite	indefinite	indefinite

https://www.gamedeveloper.com/design/the-pac-man-dossier

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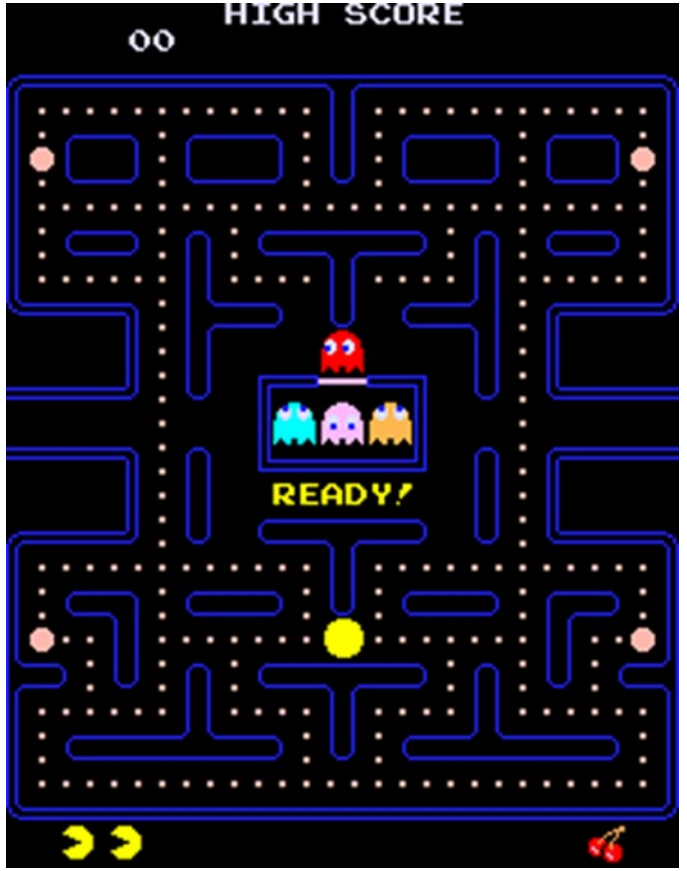
The 3 States of Pac-Man

1. **CHASE** - A ghost's objective in *chase* mode is to find and capture Pac-Man by hunting him down through the maze. Each ghost exhibits unique behavior when chasing Pac-Man, giving them their different personalities: Blinky (red) is very aggressive and hard to shake once he gets behind you, Pinky (pink) tends to get in front of you and cut you off, Inky (light blue) is the least predictable of the bunch, and Clyde (orange) seems to do his own thing and stay out of the way.

2. **SCATTER** - In *scatter* mode, the ghosts give up the chase for a few seconds and head for their respective home corners. It is a welcome but brief rest-soon enough, they will revert to chase mode and be after Pac-Man again.

3. **FRIGHTENED** - Ghosts enter *frightened* mode whenever Pac-Man eats one of the four energizers located in the far corners of the maze. During the early levels, the ghosts will all turn dark blue (meaning they are vulnerable) and aimlessly wander the maze for a few seconds. They will flash moments before returning to their previous mode of behavior.



https://www.gamedeveloper.com/design/the-pac-man-dossier

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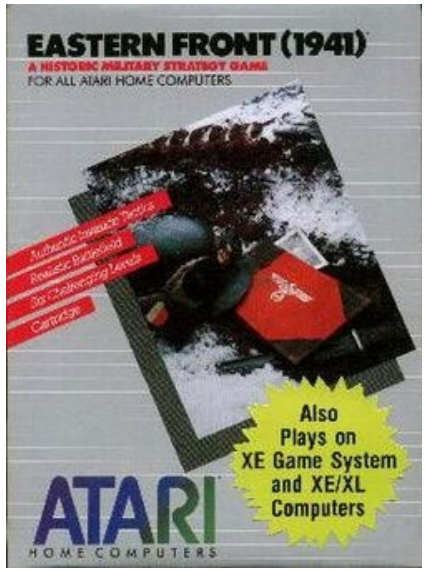
Eastern Front 1941

"Eastern Front is a corps-level simulation of Operation Barbarossa, the German invasion of the Soviet Union in 1941. The player controls the Germans, in white, while the computer plays the Russians, in red"

- Wikipedia



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Eastern Front 1941

"The AI is based on three basic measures of the game state: The strategic situation which attempts to take and hold cities, the tactical situation which attempts to block player movements, and the overall arrangement of the front line.The AI first attempts to build a continuous front line to prevent encirclements, it then sends additional units on intercept courses to block player movements, and finally any remaining units are sent to undefended cities." -Wikipedia

Review scores	
Publication	**Score**
CGW	★★★★½[22]
ANALOG Computing	9.3/10[2]
InfoWorld	Excellent[23]
Addison-Wesley	A[24]
Awards	
Publication	**Award**
Creative Computing	Game of the Year, 1981[25]
Academy of Adventure Gaming Arts and Design	Best Adventure Game for Home Computer, 1981[19]
Charles S. Roberts Award	Best Adventure Game for Home Computer of 1981[26]

"There are ways to trick the AI. One is to break the German forces into two blocks, and then advance them on alternate turns. The tactical part of the AI attempts to intercept these movements, sending its mobile forces first one way, then the other, never actually making contact." - Wikipedia

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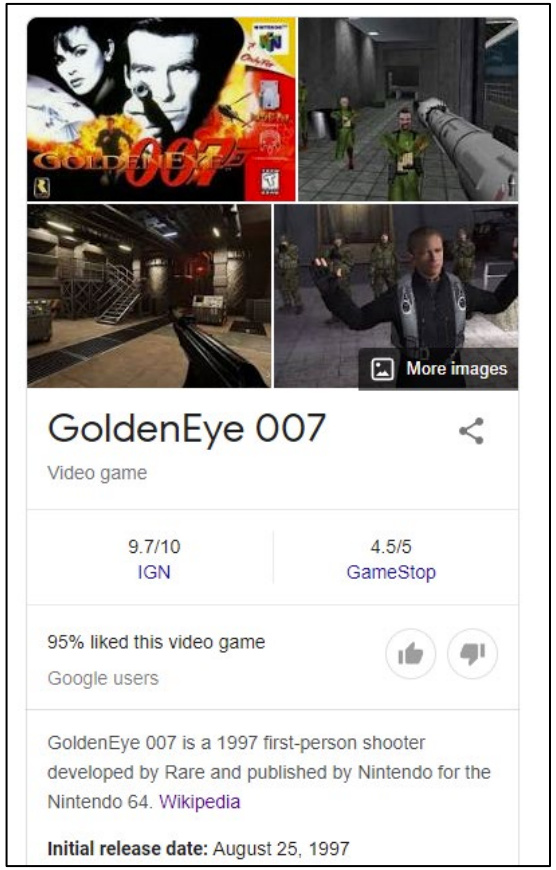
Goldeneye 007

- Goldeneye 007 (1997) advanced the field
- Still relied on characters with a small number of states
- Goldeneye added a sense simulation system:
  - characters could see their colleagues, notice if they were killed



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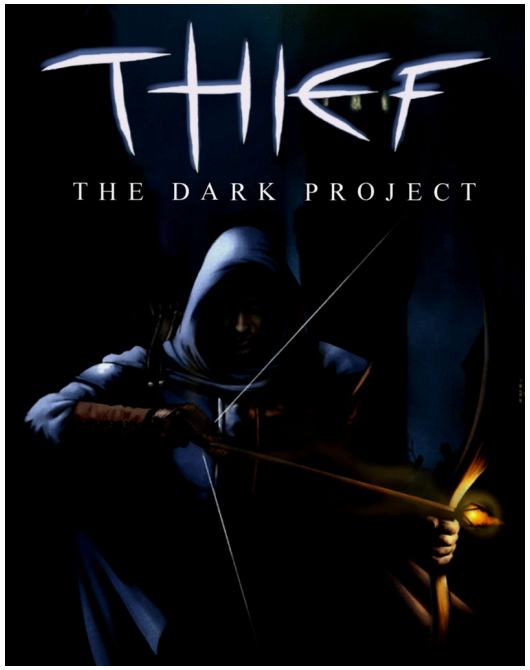
Sense Simulation

Sense simulation became very popular, central to some game design

- Thief: The Dark Project (1998)
- Metal Gear Solid (1998)



- Not super-sophisticated
  - Ray-cast + shadow check to see if object is visible to AI characters
  - Sound event tested for spatial locality to determine if audible to AI characters

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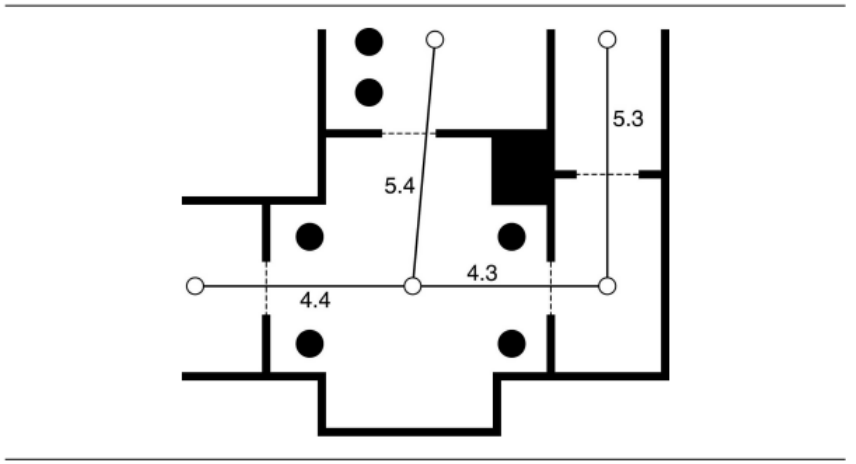
Warcraft

In the mid-1990s real-time strategy (RTS) games became popular

Warcraft was one of the first times pathfinding was obviously used



Path-finding: Graph search for shortest paths is the commonly used approach

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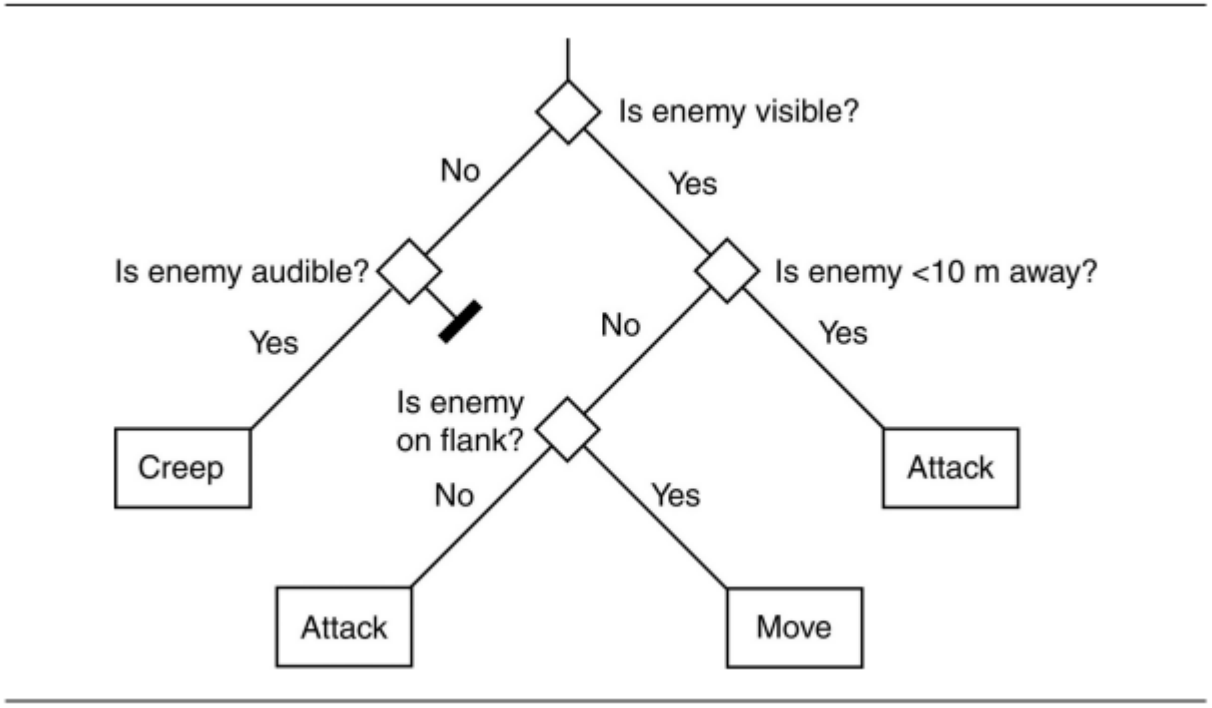
Halo

Halo (2001) introduced decision trees

Now a standard method for characters to decide what to do.



Starcraft AI Challenge

"First person shooters and RTS games have been subjected to significant academic research (there is an annual competition for Starcraft AI, for example)."

Millington, Ian. AI for Games, Third Edition

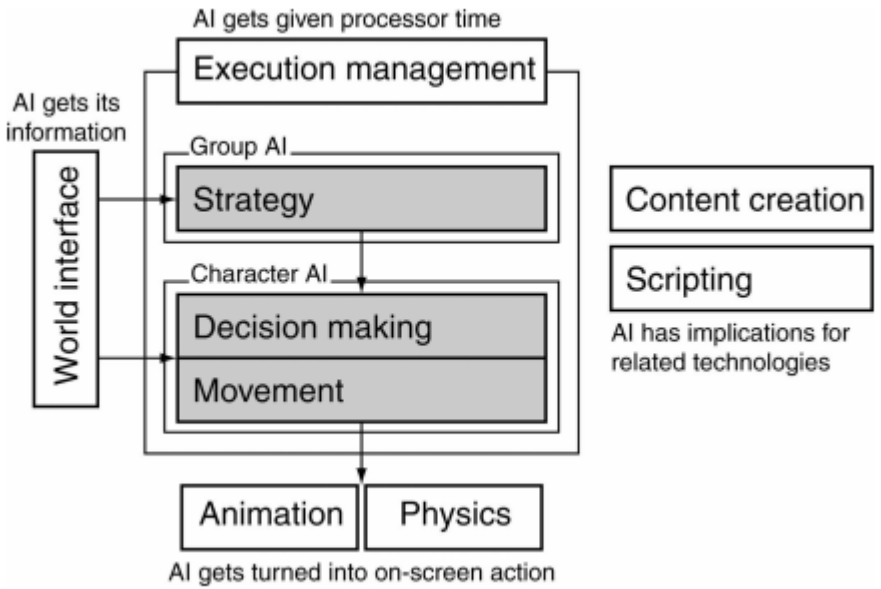
NEWS | 30 October 2019

Google AI beats top human players at strategy game *StarCraft II*

DeepMind's AlphaStar beat all but the very best humans at the fast-paced sci-fi video game.

Dan Garisto

A Model of Game AI



- Movement and Pathfinding
- Decision Making
- Strategic AI/Learning

ILLINOIS