Raven: An Overview

Artificial Intelligence for
Interactive Media and Games

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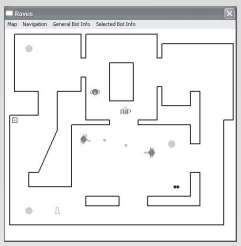
[Based on Buckland, Chapter 7 and lecture by Robin Burke]

Raven Game



- Quake-style death match
  - player and opponents (“bots”)
  - automatic respawning
  - rooms and corridors
  - weapons and health packs
- Top-down 2D simple rendering
- Player can “possess” a bot to play

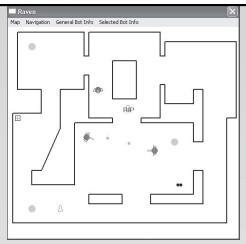
Old Techniques in Raven

- Review from IMGD 4000
  - Steering (Chapter 3)
  - Path Planning (Chapter 5, 8)
- Studied this term
  - Messaging
  - (no state machines!)

New Techniques in Raven

- Generic
  - triggers
  - sensory memory
  - **goal (behavior) trees**
  - fuzzy logic
- Genre-specific
  - targeting
  - weapon selection

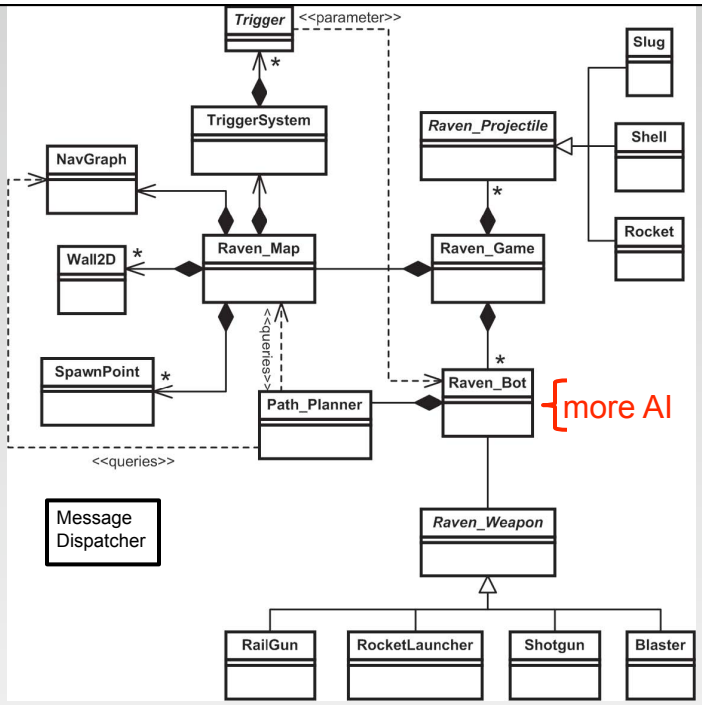
Player Controls



- Right click to select bot
  - to observe internal state
- Possess selected bot by right clicking
  - left click to shoot
  - right click on map to navigate to point (AI path planning assist)
  - mouse position determines direction of firing
  - change weapons with 1, 2, 3, 4 keys
  - X key to release
- Demo

Raven Schedule

4	Mon, Nov 16	Chapter 7	Raven Anatomy	
	Tue, Nov 17	Chapter 7	Raven Anatomy	
	Wed, Nov 18			7 - Tournament Team [10%]
	Thu, Nov 19		**Futures:** AI in Games Research at WPI	
	Fri, Nov 20		**Soccer Tournament** (IMGD Lab)	
	Sun, Nov 22			8 - My Bot [3%]
5	Mon, Nov 23		**Futures:** Natural Language and Dialog	
	Tue, Nov 24		**Futures:** Natural Language and Dialog	
	Wed, Nov 25		*Thanksgiving Break*	
6	Mon, Nov 30	Chapter 9	Goal-Driven Behavior	
	Tues, Dec 1	Chapter 9	Goal-Driven Behavior	
	Weds, Dec 2			9- Steal Health [5%]
	Thu, Dec 3	Chapter 9	Goal-Driven Behavior	
	Fri, Dec 4		**Brainstorming:** Raven Bot Strategy	
	Sun, Dec 6			10 - Bot Design [3%]



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Raven Configuration File

----------[[General game parameters]]----------

--the number of bots the game instantiates

NumBots = 3

BotNames = {}

BotNames[1] = "RB_Bot"
BotNames[2] = "Raven_Bot"
BotNames[3] = "Raven_Bot"

--- or even...

FrameRate = 2 * UpdateRate

Lua Configuration File

- Load the file as a Lua script

```
luaL_dofile(pLua, "Params.lua")
```

- Access the global variables as parameters

```
numBots = PopLuaNumber(pLua, "NumBots")
```

(no LuaBind, just Lua)

The Raven Map

- holds all world geometry
  - walls
  - triggers
  - spawn points
- supports navigation (using sparse graph)
- load from file
- map editor provided
- Demo

Raven Messages

- Combat related (bot -> bot)
  - Msg_TakeThatMF
  - Msg_YouGotMeYouSOB
  - Msg_GunshotSound
- Path finding
  - Msg_PathReady
  - Msg_NoPathAvailable
- Misc
  - Msg_UserHasRemovedBot
  - Msg_OpenSesame

Raven Weapon Properties (Config File)

- Weapon Properties
  - DefaultNumRounds
  - MaxRoundsCarried
  - RateOfFire
  - IdealRange
- Projectile Properties
  - MaxSpeed
  - Mass
  - Max Force
  - Damage

Raven Weapons

- Blaster
  - default, infinite ammo
  - 3 shots/sec, 1 unit damage
- Shotgun
  - 10 pellets spread out, 1 unit damage per pellet
  - good for short to medium range
  - 1 shot/sec

Raven Weapons

- Rocket Launcher
  - slow, medium range weapon
  - 5 units damage within blast radius
  - 1.5 shots/sec
- Railgun
  - extremely fast slug, 10 units damage
  - ideal for long-range (sniping)
  - only stopped by walls
  - 1 shot/sec

Weapon Desirability

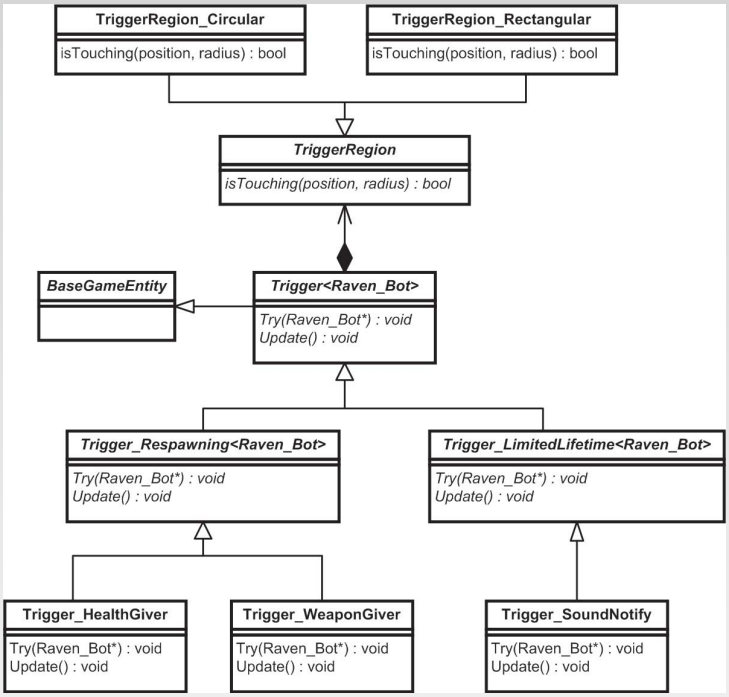
- given distance to target
- uses fuzzy logic (discuss later)
- called by AI

Projectiles

- point-mass physics simulation of flight using MovingEntity class
- when projectile intersects bot, it sends a message
  - who fired the shot
  - amount of damage done
- Code walk

Triggers

- Very generic facility (typical in game engines)
- Trigger region
  - circle, rectangle in 2D
  - sphere, cube, cylinder, etc. in 3D
- When entity enters region (and perhaps other conditions checked), triggers arbitrary action
  - graphical
  - message passing
  - state change
  - etc.



Respawning Triggers

- persistent, but becomes inactive for specified period of time after triggered
- *Weapon Giver*
  - calls PickupWeapon method on bot that triggers
- *Health Giver*
  - calls IncreaseHealth method on bot that triggers

Limited Lifetime Triggers

- automatically removed after fixed number of update steps
- *Sound Notification*
  - new trigger created every time weapon fired
  - circular trigger region proportional to loudness
  - one tick lifetime
  - when triggered, sends message to triggering bot
    - identifies shooter

Aside: Method vs. Message ?

- What's the difference between calling a *method* on the triggering bot (e.g., PickupWeapon) versus sending it a *message* e.g., Msg_GunshotSound)?
  - messages handled based on recipient's current state (or goal)
    - one more level of indirection
    - easier to extend
  - no return value from messages (cf. return message)
  - messages support optional time delay
  - messages allow easier networked implementation
    - but still need to "serialize" parameters

Managing Triggers

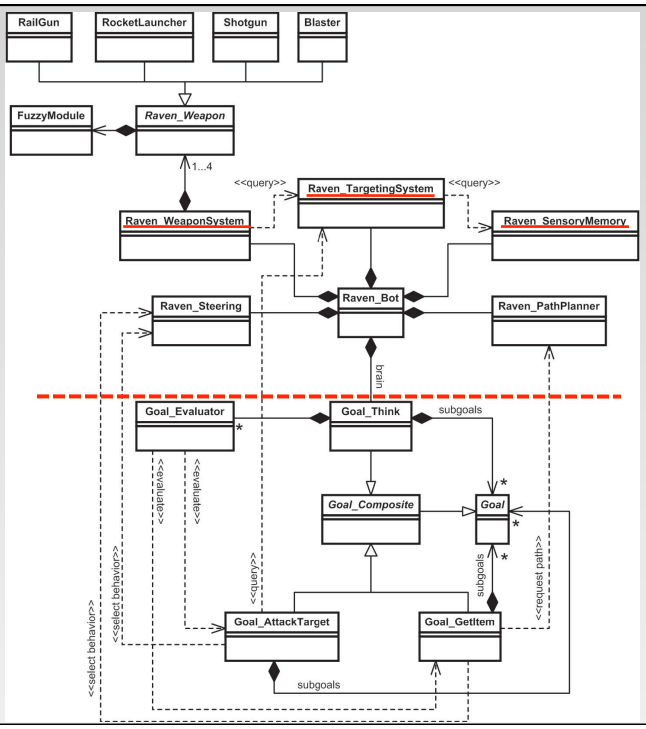
- TriggerSystem singleton
  - registers all triggers
  - updates triggers ('update' method)
  - renders active triggers
  - removes dead triggers
  - calls 'try' method on each active trigger
- Code Walk

Bot Intelligence

- *weapon handling* and *movement* operate totally independently!
  - at "lowest" level of AI, *always* choosing best target and weapon, aiming and shooting
  - higher level AI deals with "strategy", which in this game means *where* to move (uses goal trees--- see *next week*)
  - heading (for aim) controlled separately from direction of movement

Low-Level Bot Intelligence

- *Generic*
  - **Perception**
    - field of view
    - sensory memory
  - Steering
    - seek, arrive, wander, wall avoidance, separation
    - no collision detection or response between bots and world geometry
  - Path Planning
    - navigation grids provided by map
- *Genre-Specific*
  - **Target Selection**
  - **Weapon Handling**



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Modeling Perception

- can make a big difference in playability of certain types of games
- NPC's do not *inherently* have perceptual systems
  - can theoretically know everything about game state
  - *sometimes* this knowledge is needed to compensate for their stupidity
- But
  - designer must be very judicious
  - too *much* or too *little* perceptual knowledge can be bad

Too Much Perceptual Knowledge

- seeing through walls
- eyes in the back of his head
- seeing in the dark (w/o night goggles)

"perceptual omniscience"

Too Little Perceptual Knowledge

- deaf (e.g., to huge explosion nearby)
- blind (to unexpected objects)
- out of sight / out of mind

"selective sensory nescience"

Perceptual Modeling in Raven

- Field of View
  - 180 degrees
  - cannot see other bots through walls
    - requires expensive calculation
  - "knows" the location of health packs and weapons
    - unfair?
- Audio Triggers
  - omni-directional
  - distance-limited
- Sensory Memory

Sensory Memory Records

- For each opponent (as encountered)
  - most recent sensory event (seen or heard)
    - time
    - position
  - when first became became visible (seen)
  - when last visible (seen)
  - within field of view?
  - shootable? (no obstructions)
- Sensory memory updates list of such records
  - GetListOfRecentlySensedOpponents

Target Selection

- each bot has its own TargetingSystem instance
- current target updated regularly (param)
  - may be null
- Raven bots targeting criterion:
  - closest opponent
- other ideas:
  - weakest opponent in range
  - opponent that is shooting me
  - restrict to field of view (unless hear?)
  - etc...

Weapon Handling

- each bot has its own WeaponSystem instance
- currently selected weapon and inventory
  - max one weapon of each time in inventory
- performance “imperfections”
  - reaction time
  - aiming accuracy
- aiming persistence (after opponent disappears)
- key methods
  - SelectWeapon
  - TakeAimAndShoot

Update Frequency

- cannot update all AI components all the time
  - too expensive
  - not necessary
- Steering: every update (don't run into walls)
- Weapon selection: 2 Hz
- Sensory memory update: 4 Hz
- Goal arbitration (next week): 2 Hz
- note Regulator class

Upcoming Events

- **Weds** midnight: Soccer Tournament Team due
- **Thurs** "Futures" lecture on AI & Games research at WPI
- **Fri** Soccer Tournament in IMGD Lab
- **Sunday** midnight: "My Bot" homework due
  - copy and rename into folder (as before)
  - make small change in targeting
    - add special check for target within range that can kill with single firing of currently selected weapon
- Raven Code Walk