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Lecture 5

Rules and Mechanics

Today's Lecture

- Reading is from Unit 2 of *Rules of Play*
  - Available from library as **e-book**
  - Linked to from the lecture page

- Not required, but excellent resource
  - Important for the serious designer
  - And ignore the Amazon reviews…

- The "Bible of Game Mechanics"

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What are Rules?

- Definition from *Rules of Play*:

  - Rules are *formal schemas*

- But what does this really mean?

- Is it different for digital games?

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Challenge of Defining Rules

- They do not need to be *fixed*
  - **Example**: *Nomic* (simulates democratic voting)
  - But are changed in structured ways

- They can *ignored*
  - House-rules that add or remove rules
  - Rule relaxation (e.g. playing with a young child)

- They are not always *explicit*
  - **Example**: does *Halo* have rules on camping?

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Implicit Rules

- Rules beyond the explicitly stated ones

- Implicit rules for Tic-Tac-Toe
  - Must move in a "reasonable" amount of time
  - If loss is inevitable, must move or forfeit

- Often have to do with **social conventions**
  - If violate them, no one wants to play with you
  - Encapsulate being a "good sport"

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Rules and Digital Games

- Much more rigidly defined (in the software)

- Possible to change in very structured ways
  - Difficulty settings have a list of rule "alternatives"
  - But arbitrary house rules are difficult (mods?)

Difficulty	Friendly Fire (PC)	Friendly Fire (PS3 Xbox)	Flat Attack Bonus	Flat Defense Bonus	Flat Damage Bonus	Healing Effects Multiplier	Damage Threshold	Enemy Resist Bonus	Player Resist Bonus	Potion Cap	Trap Damage Multiplier	Comments
Casual	None	None	20	20	5	1.5	3	-10%	10%	20	0.5	Easy AI
Normal	50%	None	0	0	0	1	7	1.5%	0%	12	1.0	Moderate AI
Hard	100%	50%	0	0	0	0.85	9	2.5%	0%	8	1.25	Full AI
Nightmare	100%	100%	0	0	0	0.85	16	5%	0%	0	1.50	Full AI

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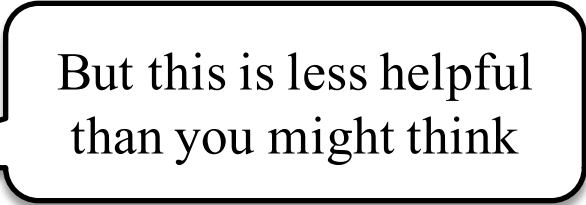
Implicit Rules in Digital Games

- Implicit rules exist in digital games too
  - Camping in shooters
  - Juggle combos in fighters

- Depend upon context, and can change
  - Casual vs. core gamers in network play
  - Official vs. private game server

- Exist because cannot specify everything

- Commonly implemented via "terms of service"

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(Formal) Rules in a Digital Game

- **Game State**: collection of values that represent the game world at a specific moment in time
  - Location, type of all the game objects
  - Non-spatial values (e.g. health) of these objects
  - Global non-spatial values (e.g. difficulty)
  - A high-dimensional tuple $v = (v_1, v_2, v_3, \ldots)$

- **Possibility Space**: collection of all game states that are allowable (via the rules) in the game
  - Formally, we denote this space $\mathbb{S}$

- A **rule** is a function $f: \mathbb{S} \rightarrow \mathbb{S}$

> But this is less helpful than you might think

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How to Design Good Rules

- Player must have *meaningful choices*
  - Player must be able to make decisions
  - System must respond in significant way

- **Bad Rules**: Guess heads or tails to pick a winner
  - All you can do is guess the answer
  - Has no significant effect on the outcome

- **Bad Rules**: Move pieces on board with no interaction
  - Actions have no meaning since pieces don't interact
  - There are no victory conditions or even challenges

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Mechanics versus Rules

Mechanics

- *Informal* design concept

- Can represent activity over multiple animation frames

Rules

- *Formal* implementation
  - Corresponds to code
  - Typically at the level of an animation frame
  - Though can have multiple rules per animation frame

- Goal is to match design
  - Is behavior correct?
  - Is behavior expected?

Formalizing Mechanics

- **Actions** take player input I and current state
  - Express as a function $g: \mathbb{I} \times \mathbb{S} \to \mathbb{S}$
  - But could simplify; have input part of state

- **Interaction**: function between game states
  - Just like a rule, $f: \mathbb{S} \to \mathbb{S}$

- *Order* is another important consideration
  - Multiple actions, interactions possible per frame
  - How does order affect them? *Will return to this*

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Verbs vs Interactions

- **Design Idea**: minimalism
  - Game with very few verbs
  - Mechanics are all interactions
  - Common in mobile, tablet

- **Example**: Sneak Beat Bandit
  - Has only one verb: *move*
  - Rhythm game; move to beat
  - All movement on rails
  - If obstacle in way, turn
  - Line-of-sight mechanics

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Beat Sneak Bandit

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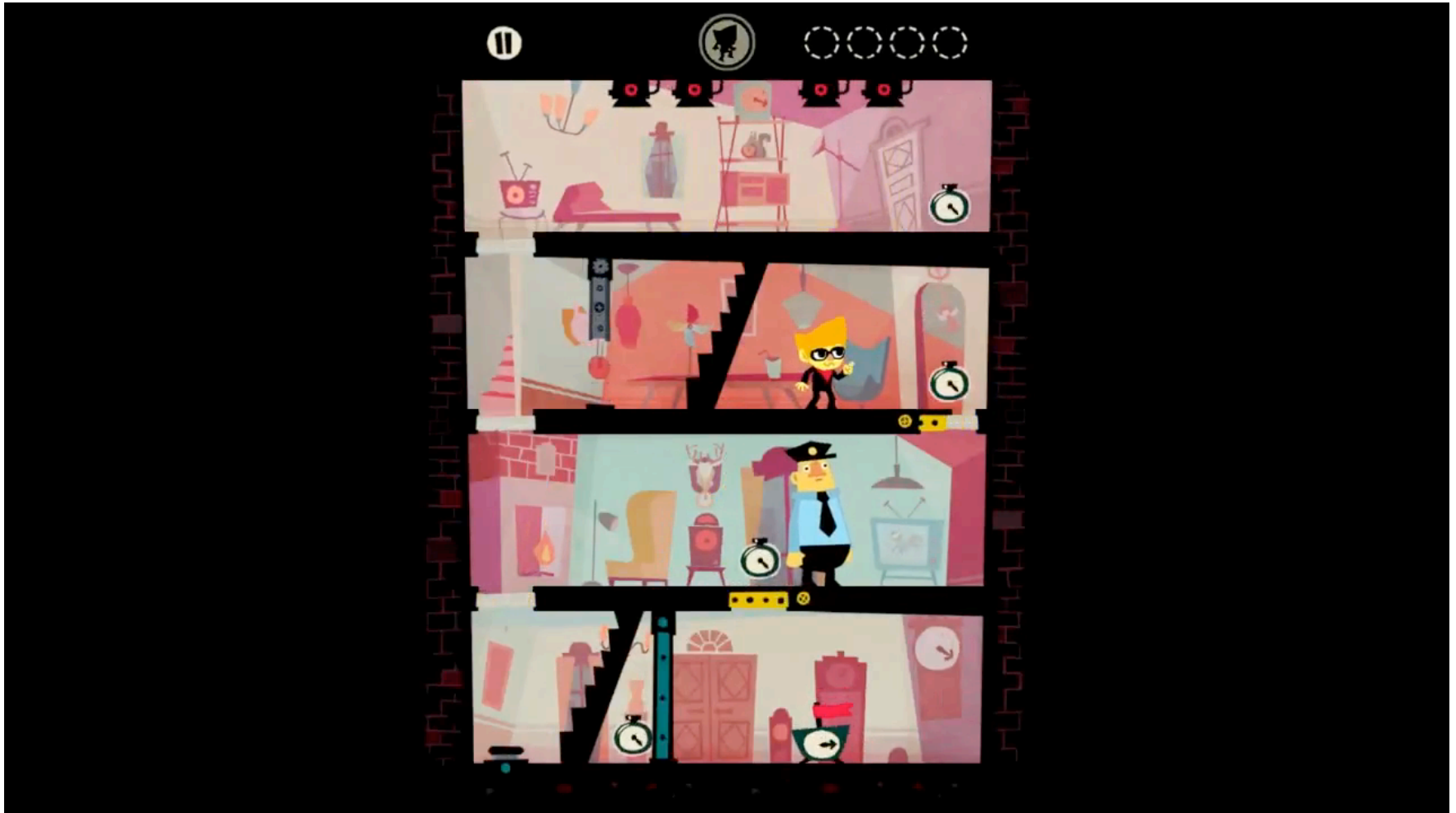
Combining Actions

- Verbs can combine in interesting ways
  - Run and jump in a platformer
  - Strafing fire in a shooter

- Typically result of the interactions
  - Each verb interacts with environment in different way
  - Combination of two give extra feature for "free"
  - This is an example of **emergent behavior**

- Not all combinations are emergent
  - **Example**: Double jump is not a feature of interactions
  - This type of verb combination is a *distinct action*

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Combining Actions

Running Jump

- Can move while in midair
  - Just horizontal movement
  - Not realistic; it is a game
  - Many platformer challenges assume this type of control

- Different than a *long jump*
  - Less height than reg. jump
  - No control once in the air
  - Would be a **distinct action**

Strafing Fire

- Based on "real life" property
  - Bullets travel in straight line
  - Movement changes origin
  - Walking side-side makes a spray (used in covering fire)

- But some features are gamy
  - Bullets slower than life
  - Character faster than life
  - Creates interesting effects

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Combining Actions

(Long) Jump

Interaction(?)

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Combining Actions

Is this an example?
Why or **why not**?

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Understanding Game State

- Many game state values are **spatial**
  - Represent location of a game *entity*
  - Also physical values like velocity, acceleration

- Entities act as containers for non-spatial values
  - Values that never change: **attributes**
  - Values that can change: **resources**

- Attributes, resources can be global as well
 - Though most mechanics are at entity level…

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Actions Affecting Spatial State

- Typically we what we would call *movement*
  - Present in all but the most abstract games

- But there are many ways to implement
  - **Direct** movement of avatar (e.g. WASD)
  - **Indirect** movement of avatar (e.g. pathfinding)
  - Alter the **environment** (e.g. removing platforms)

- Area of much potential *innovation*

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Altering the Environment

- Found in "physics" games
  - No direct control of avatar
  - Can only remove/add/move obstacles in environment
  - Movement is "natural"

- **Example**: *Screw the Nut*

- Physics is a rule system
  - Interaction, not action
  - Takes one state to another
  - Also one that is complex to understand/model

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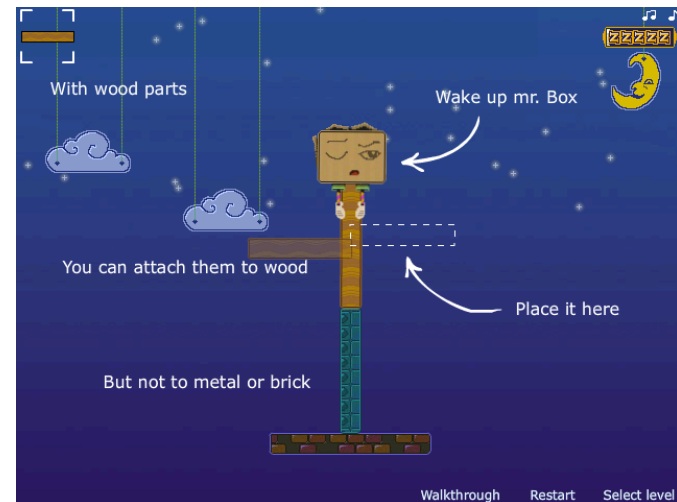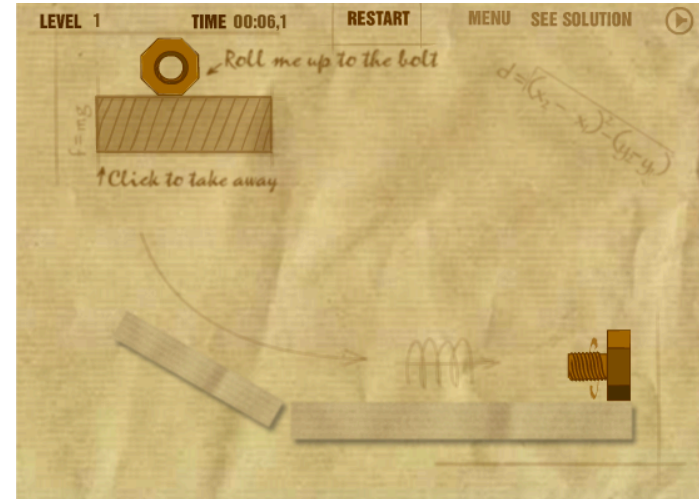
Innovating Avatar Movement

- 2D games move on 2-axes
  - Classic: left-right/up-down
  - Unless top-down game, one of these axes is restricted

- Is jump the only option?

  Others?

  - Launcher/trajectory verbs
  - (Limited) teleportation

- **Example**: *Knightmare Tower*
  - Launcher-style game
  - Vertical movement is boosts gained from killing enemies

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Environment **AND** Avatar

- Possible to split the verbs
  - Some for avatar movement
  - Others for environment

- Found in "drawing" games
  - Draw missing platforms
  - Avatar walks on platforms
  - **Ex**: Max & Magic Marker

- Innovate by limiting avatar
  - Move on single axis
  - Combine with environment
  - **Example**: Swindler

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"Deep Gameplay"

- Want many ways to overcome challenges
  - **Example**: kill enemy or sneak past
  - If just one way, gameplay is "shallow"

- Shallow challenges hurt replayability
  - "Twitch" challenges become boring fast
  - Cerebral challenges solved by the walkthrough

- All games should have a strategic element

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Strategy

- **Definition**: an elaborate sequence of steps
  - Action is the culmination of all the steps
  - Changing steps or order changes action

- Still allows for puzzle gameplay
  - Allow some *flexibility* in these solution steps
  - **Example**: Multiple solutions to Rubik's Cube
  - **Example**: Time-rewind in *Braid*

- *Resources* are a common way to implement

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Resources and Gameplay

- Resources are crucial to "combat" mechanics
  - Entities have resource values (e.g. health, ammo)
  - Expend resources to affect others (e.g. attack)
  - May change resources of that entity (e.g. damage)

- Three basic categories of resource combat
  - **Tug-Of-War**: entities take from each other
  - **Dot Eating**: entities race to gather *limited* resource
  - **Flower Picking**: race to gather *unlimited* resource

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Resources and the Game Economy

- **Sources**: How a resource can increase
  - **Examples**: ammunition clips, health packs

- **Drains**: How a resource can decrease
  - **Examples**: firing weapon, player damage

- **Converters**: Changes one resource to another
  - **Example**: vendors, *Starcraft* barracks

- **Traders**: Exchange resources between entities
  - Mainly (but not always) in multiplayer games

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Economic Challenges

- You can use resources to
  - Control player progression (hinder or advance)
  - Modify player abilities (limit or enhance)
  - Create a large possibility space (for replay value)
  - Create strategic gameplay

- Do not need a lot of resources
  - Not every game is a strategy game
  - But **almost all** games have some economy

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Resources as Dilemma

- Players perform cost-benefit analyses
  - Cost: resource change not beneficial to player
  - Benefit: resource change beneficial to player

- **Example**: Survival Horror
  - Use ammo to shoot zombie (Cost: ammo)
  - Use knife to stab zombie   (Cost: health)
  - Benefit the same in each case

- Players act with least cost for benefit

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Resources and Monetization

- Most resources are gathered in-game

- But some games allow **external sources**
  - Get resources from a friend on Facebook
  - Pay for resources with a credit card
  - Known as resource *monetization*

- Free-to-play, pay-for-stuff
  - Modern business model for online games
  - Subscription model is (mostly) dead

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Example: *Free Realms*

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Complexity in Games

- Why is Tic-Tac-Toe unpopular w/ adults?
  - Experienced players always draw
  - Very easy strategy to memorize

- The game is too simple; needs to be complex
  - But if game is too complex, no one will play

- Complexity best through *emergent behavior*
  - "Coupled, context-dependent interactions"

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Emergent Behavior

- **Coupled Interactions**
  - Two mechanics that can happen at once
  - **Verbs**: jump AND run in a platformer
  - **Resources**: warrior AND archer in an RTS

- **Context-dependent Interactions**
  - Mechanics combine to give new behavior
  - **Verbs**: jump and run is new form of movement
  - **Resources**: warriors form wall to cover archers

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Emergent Behavior

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Common Spatial Interactions

Collisions

- Can effect *resources*
  - Player takes damage
  - Player gains power-up
  - Player-NPC transfer gold
- Can effect *spatial values*
  - Bounce off collision point
  - Swing from attached rope
  - Attraction to magnet/charge

Detection

- Examples:
  - Line-of-sight (w/ obstacles)
  - Spatial proximity
- Can have *direct* effects
  - Alarms in a stealth game
- Can have *indirect* effects
  - Tower defense targeting
  - Adjust NPC reactions

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Resource-Spatial Interactions

Resource Affects Spatial

- Resources can unlock areas
  - Keys are a trivial resource
  - Also use resource thresholds
  - **Ex**: Collect all tokens to pass

- Resources affect difficulty
  - Adjust input device sensitivity
  - **Ex**: Deadeye meter in *RDR*
  - **Ex**: Jet packs to increase jump

Spatial Affects Resources

- Resources made by entities
  - Have a spatial location
  - **Ex**: Time to transfer resources
  - **Ex**: Sources be captured

- Resource values are entities
  - Take up physical volume
  - Need space to acquire
  - **Ex**: Inventory in *Deux Ex*

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Resource-Spatial Interactions

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Coupling is not Enough

- Example of *trivial* coupling:
  - RTS with single unit type – warrior
  - Coupling can arise from multiple warriors
  - When attack, count number on each side

- Group of warriors **is** sum of its parts
  - Just make a single warrior stronger
  - Discover from *resource analysis*

- Emergent behavior must couple *nonlinearly*
  - If n base mechanics, more than $O(n)$ behaviors

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Example: *Starcraft*

- Basic units can

  - Attack in sky and/or land

  - Defend in sky and/or land

  - How can these combine?

- Further complexity:

  - "Buff" friendly units

  - "Control" enemy units

  - How does this affect game?

- **Challenge**: What is minimal complexity for a good RTS?

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Summary

- Rules are **formal systems** defining your game
  - Take one game state and produce another
  - Implementation of mechanics (a design concept)

- Game state is broken into two categories
  - **Spatial values** are attached to game *entities*
  - **Resources** create economy and *strategic* gameplay

- Good rules should
  - Allow for *meaningful play*
  - Allow for *emergent behavior*

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