Centrum Wiskunde & Informatica

Hogeschool van Amsterdam
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Adapting Game Mechanics with Micro-Machinations

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Joint work with
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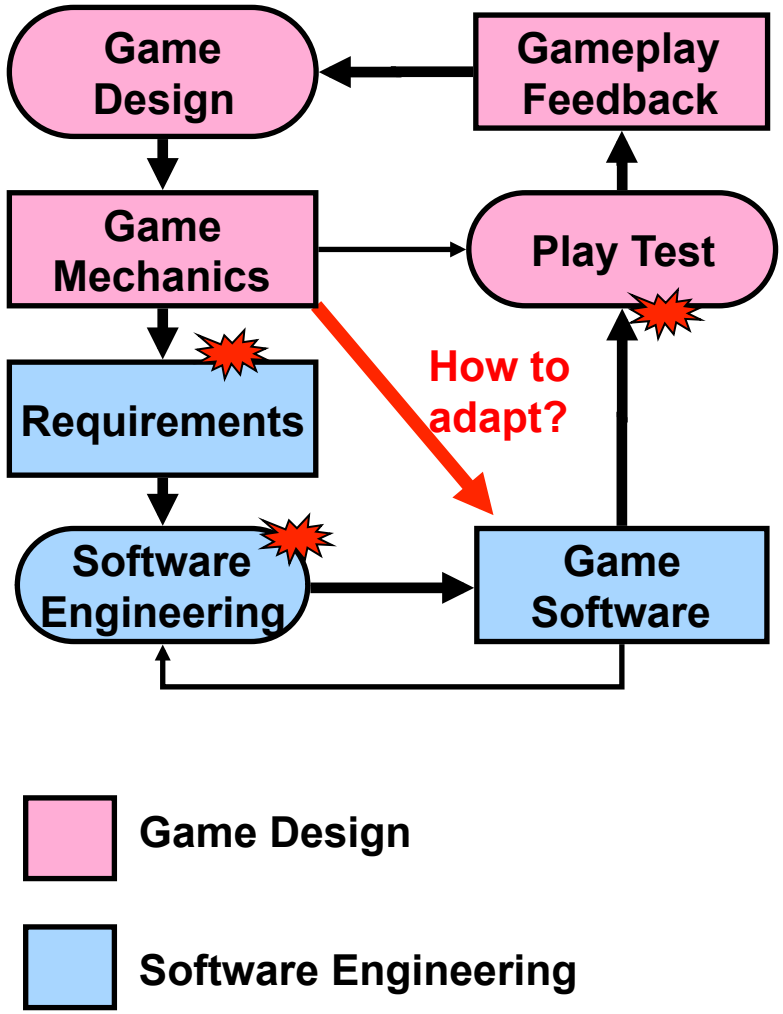
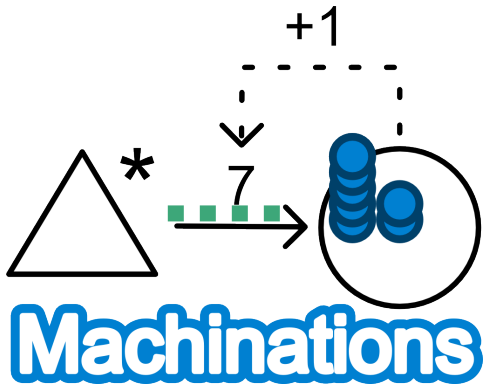
Problem Statement, Objectives and Approach

- Problem
  - Long design iteration times because designers lack a means of adapting game mechanics in software
- Objectives
  - Reduce game design iteration times
- Approach
  - Live adaptation of game mechanics with Micro-Machinations



Machinations Background

- Visual modeling language for game design
- Diagrams are directed graphs
- Expresses game mechanics
  - Depicts internal economy
  - Makes feed-back loops explicit
- Works by redistributing resources between nodes along the edges

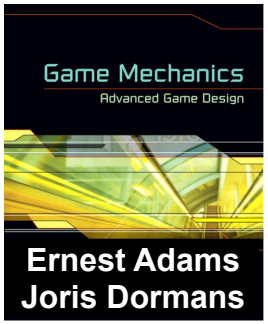


The Machinations logo contains a feed-back loop

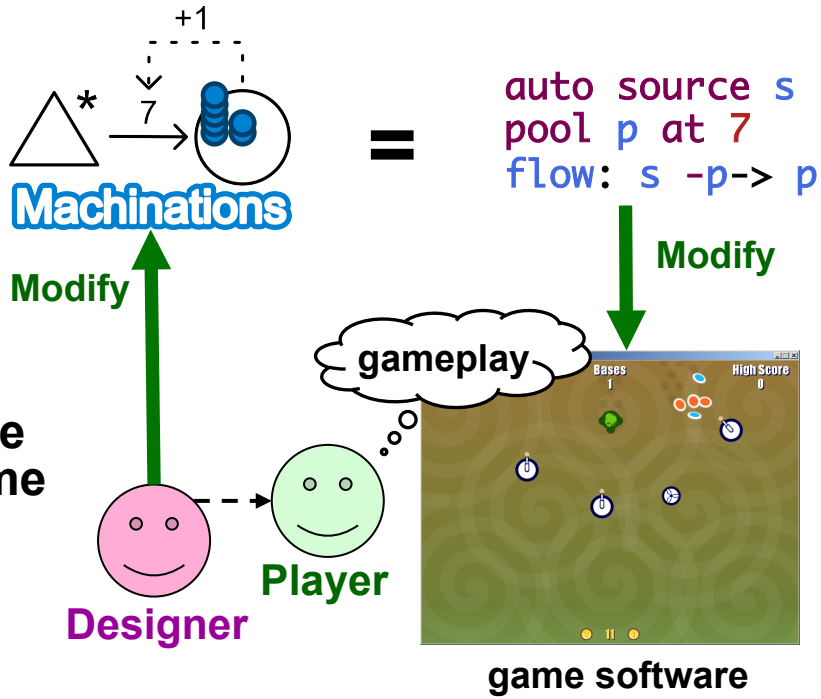
state	0	1	2	3	4
amount	7	14	28	56	112
flow	7	14	28	56	112

Machinations Language Evolution

1. Game Design Aid
   - Prior work of Ernest Adams and Joris Dormans
   - Helps understand how rules affect play
   - Limited to game design



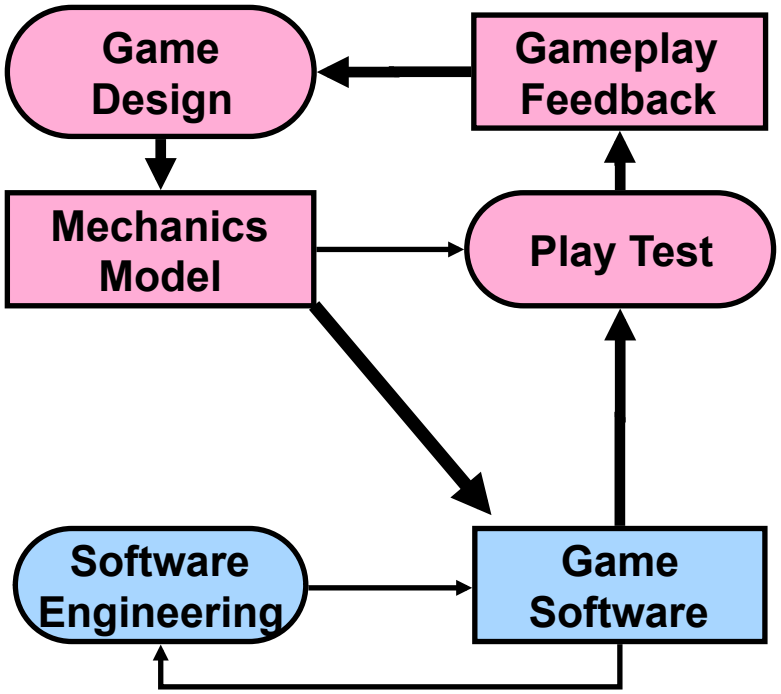
2. Analyze Micro-Machinations
   - Prior work with Paul Klint
   - In MM we formalized Machinations' meaning and extended the language
   - Added a textual notation



3. **Live Adaptations**
   - **We make MM embeddable in game software and modifiable at run-time**
   - **We provide the embeddable MM Library and language extensions for modifications**
   - **Helps experiment and play test for gaining immediate feedback**

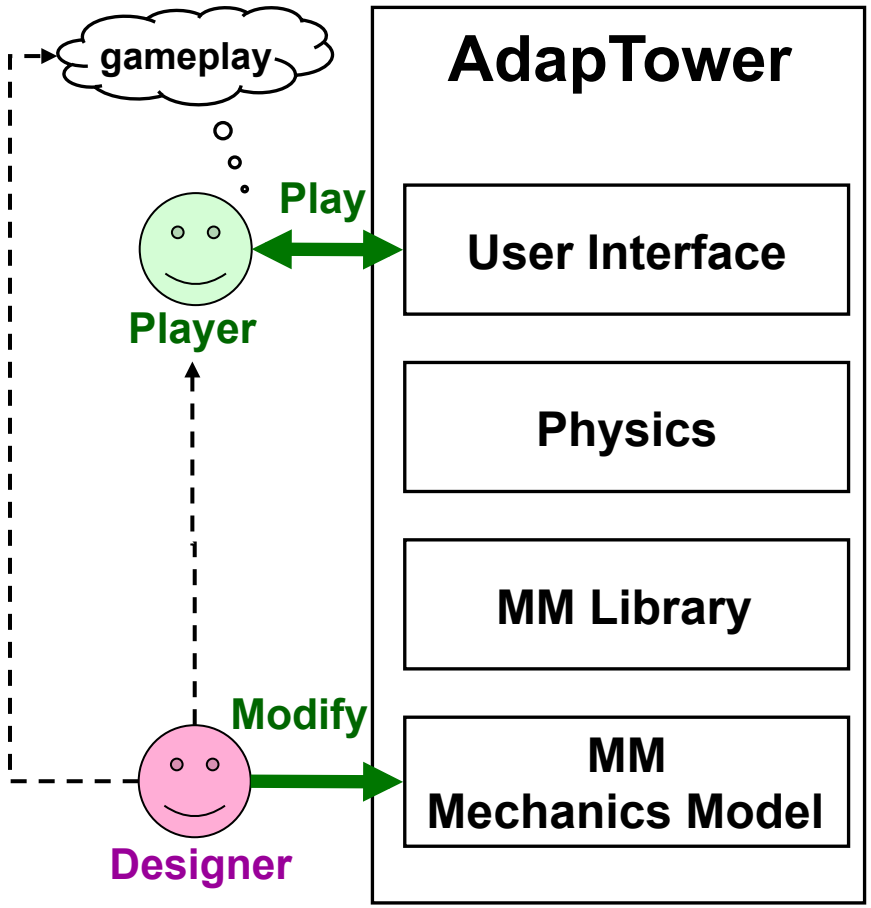
Why Live Adaptations?

- **Speed-up** of game design
  - reduced game design iteration times
  - immediate feedback in play testing
- **Quality and Productivity** improvement opportunities
  - short iterations → more improvements possible
  - software reuse → lower chances for new bugs



Case Study: AdapTower

- Prototype game in the Tower Defense genre
- Embeds the MM Library
  - Written in C++ ‘platform independent’
  - 3-clause BSD License
- Demonstrates how MM can be used to adapt game mechanics → gameplay



Case Study: AdapTower

- Creeps spawn into the world

- Two kinds of buildings
  - Towers
    - kill creeps
    - produce essence

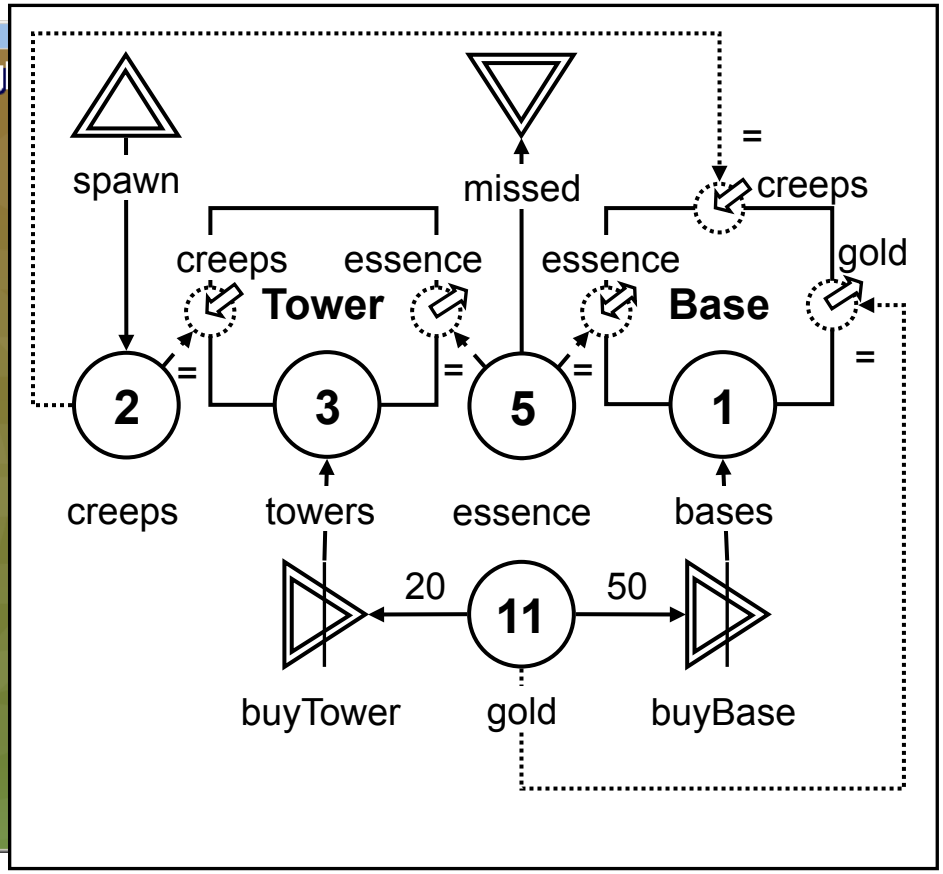
  - Bases
    - catch essence
    - produce gold

- Players can spend gold
  - Buy a tower for 20 gold
  - Buy a base for 50 gold

AdapTower: Demo

AdapTower: Internal Mechanics

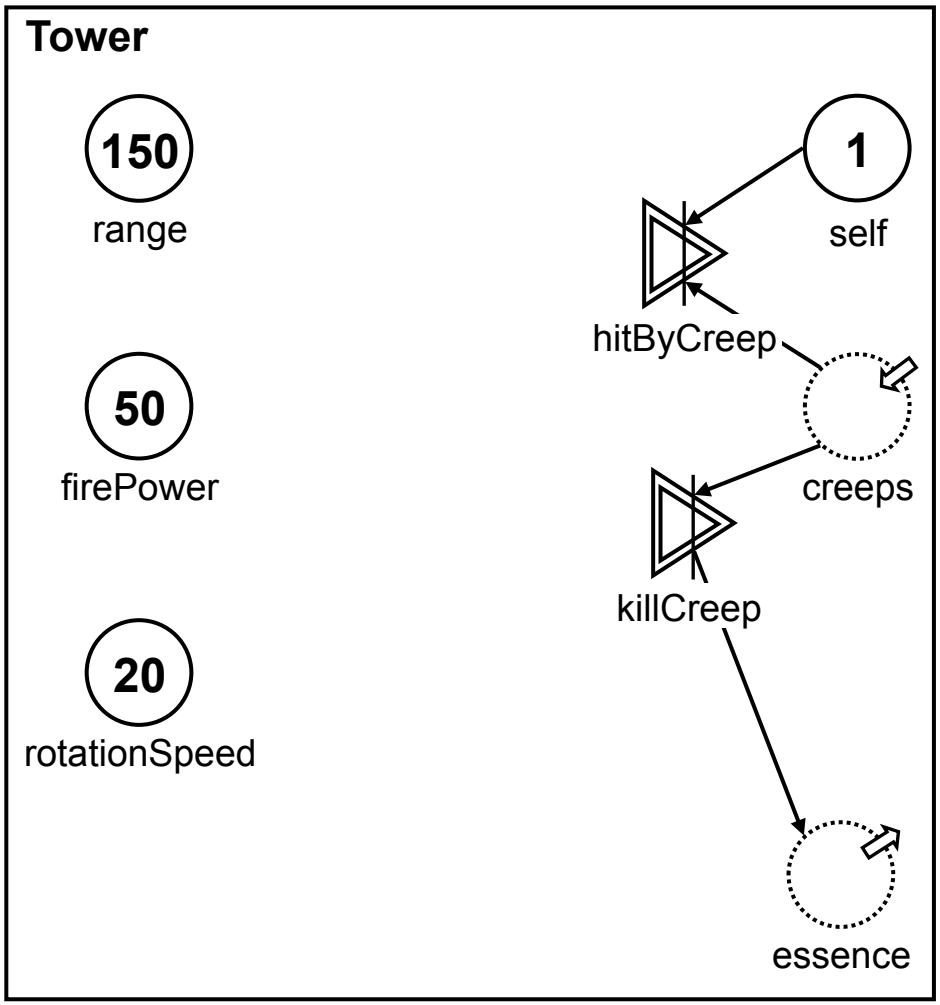
Let's count the number of creeps, towers bases, essence and gold



Visual Micro-Machinations run-time state

AdapTower: Tower Mechanics

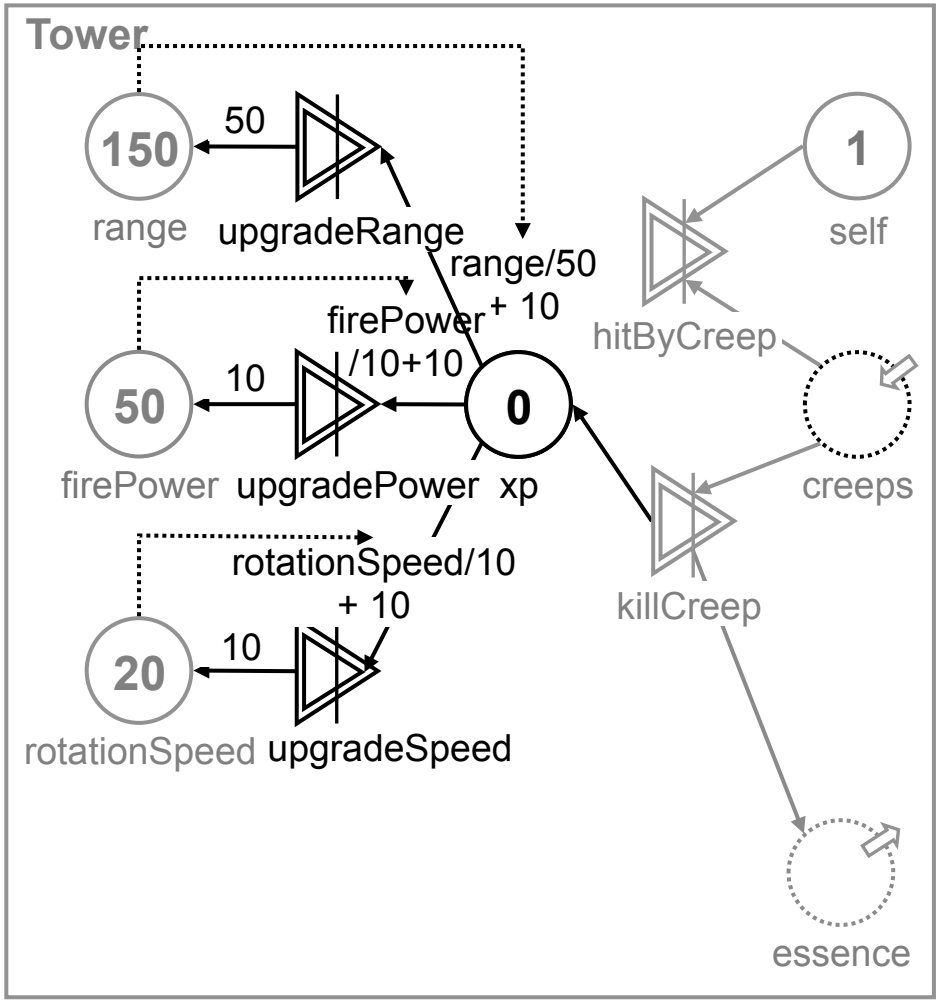
- range, firePower and rotationSpeed affect physics
- towers kill creeps and produce essence
- creeps that hit towers destroy them



Visual Micro-Machinations of the Tower Definition

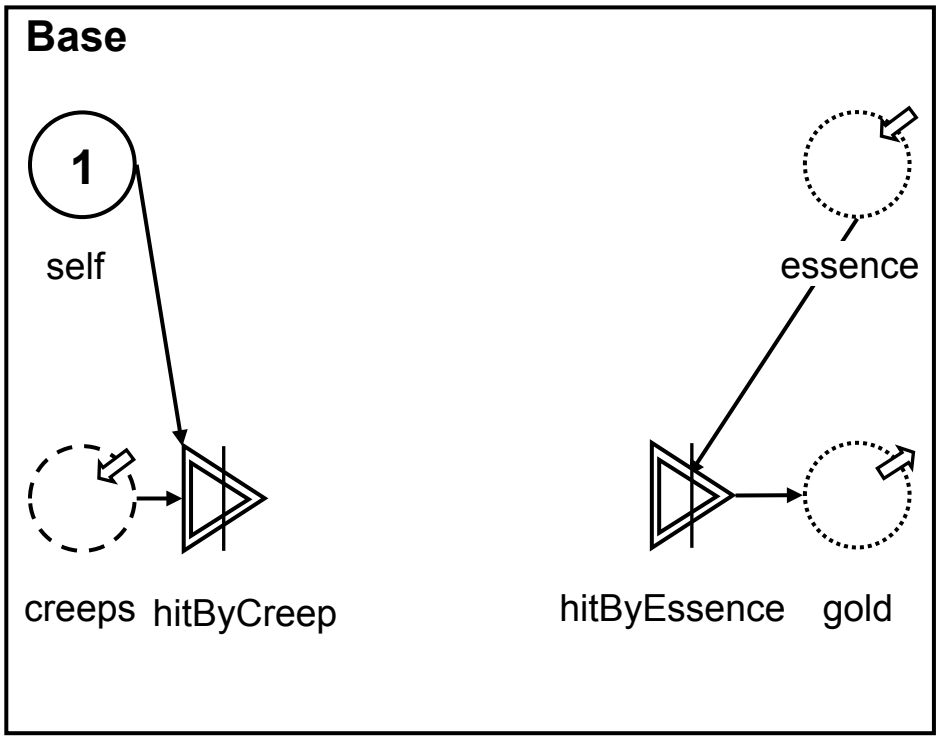
AdapTower: Tower Mechanics Mod

- Problem
  - All towers act alike
- Adapt gameplay design
  - Allow specific upgrades
- Mechanics modeling
  - Add upgrades
  - Towers gain xp
  - Upgrades cost xp, and cost more each time



AdapTower: Base Mechanics

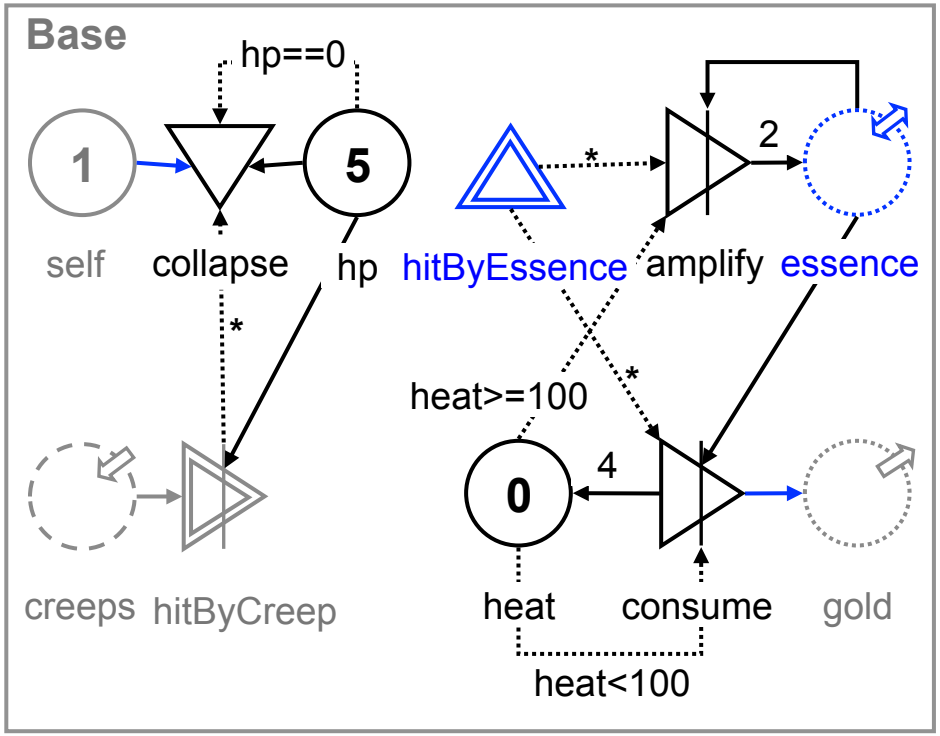
- Creeps that hit a base destroy it
- When hit by essence a base produces gold



Visual Micro-Machinations of the Base Definition

AdapTower: Base Mechanics Mod

- Problem
  - Players are discouraged from placing bases near the top of the screen
- Adapt gameplay design
  - make bases more sturdy
  - reward high risk
- Adapt mechanics model
  - hp determines how many hits a base can take before collapsing
  - When bases convert resources they heat up
  - when overheated (>100) bases amplify essence instead



AdapTower: Demo Modifications

Conclusions

- **Adaptability** of game mechanics with Micro-Machinations
  - live mechanics modifications
- **Speed-up** of game design
  - reduced game design iteration times
  - immediate feedback in play testing
- **Quality and Productivity** improvement opportunities
  - short iterations → more improvements possible
  - software reuse → lower chances for new bugs
- **Case study** demonstrating the approach