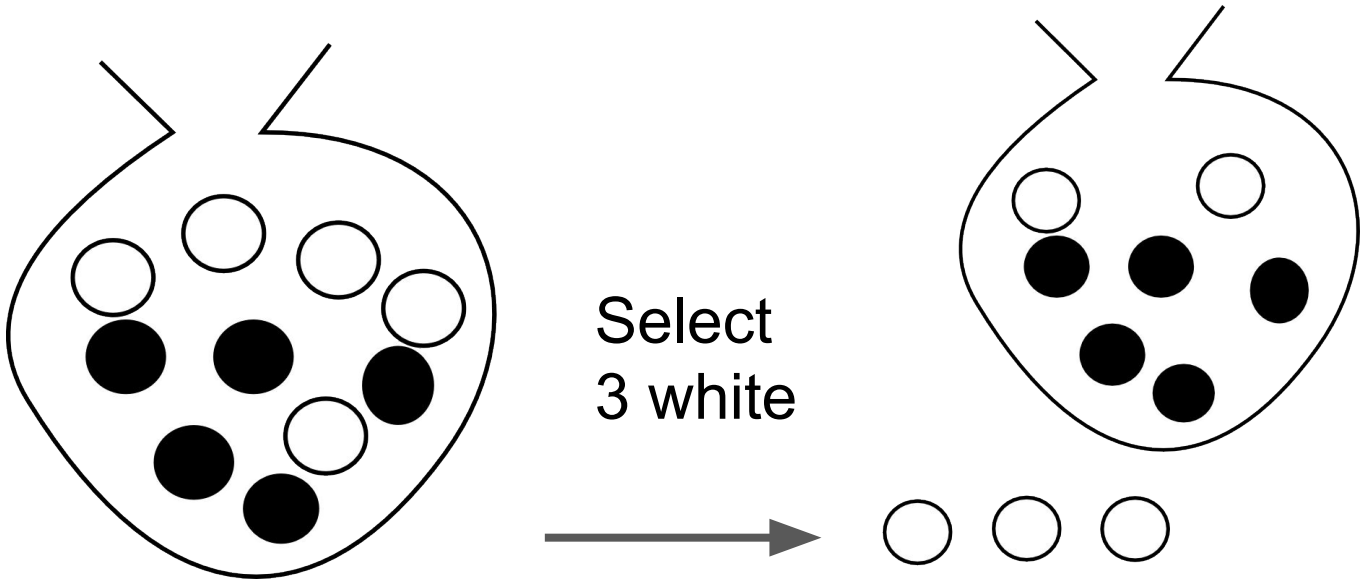
Game Balance and Chance

COMP313 Computer Game Development

Games and Chance

- You understand fractions and %
  - Technical understanding - sometimes without intuition
- Dig a little
  - The sum of Linear Random Selection is not linear.
    - Combine two linear distributions and you get a gaussian
  - MonteCarlo sampling
    - Add a small amount of randomness to your sampling to avoid aliasing
- Expected value
  - What is the expected return from an action
  - (Risk * prob. Failure) + (Reward * prob. of success)
- Humans are terrible at understanding probability
  - Gambling is still popular

Knapsack - Model



Black	White
50%	50%

Black	White
71%	29%

Skill and chance

- Estimating probabilities
  - Poker understanding the probability of card draws?
  - Texas Hold'em house always wins
- Humans do not understand independent chance
  - Pigeons do better at getting rewards from 80/20 buttons
  - We try to control chance with superstitions
- In your game?
  - What is random, and what **feels** random?
  - What is the experience of the randomness – arbitrary or exciting?
  - Risk taking is about estimating expected values

Types of Balance

- Many types of balance
  - Difficulty
  - Choices
  - Chance
  - **Fairness**
  - Skill vs Strategy
  - Competitiveness vs Cooperative
  - Length
  - Rewards
  - Freedom vs scripted
  - Complexity vs clarity
  - Imagination vs familiarity

Fairness

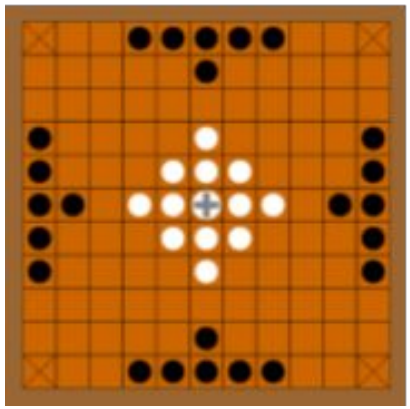
- Players with similar abilities should have similar chance to win (at the start of the game)
- Mostly applies to setup of the game
  - Choices after start can lead to “unfair” situations
  - Some variation in probability okay
- Can be used as a form of handicap – if clearly defined
  - Players creating balance with different skill levels
  - Hard vs easy modes creating different start positions

Symmetry

- Creating balance
  - Symmetric start position (identical options)
  - Identical forces
  - Identical capabilities
- Asymmetry still happens
  - Chess, monopoly, checkers
  - Who starts first?
    - Make the first move of little value
    - Play multiple sessions
  - Sports – home and away

Asymmetric

- This is tricky
- Different forces with different capabilities
  - Starcraft
  - Street fighter – most fighter games
  - Civ games
  - Hnefatafl
    - http://aagenielsen.dk/hnefatafl_white11.html
- Balance with math
  - trial and error



Multiple sessions

- Meta balancing
- Play game as white, then as black
  - Player with the most combined points wins
  - Imbalance in objectives
    - First player does not know if they have enough points
    - Sometimes easier for second player with known objective
  - Tennis
    - Change who is serving
    - Change ends
- Series of events – different places and environment to balance out the game

Balancing abilities

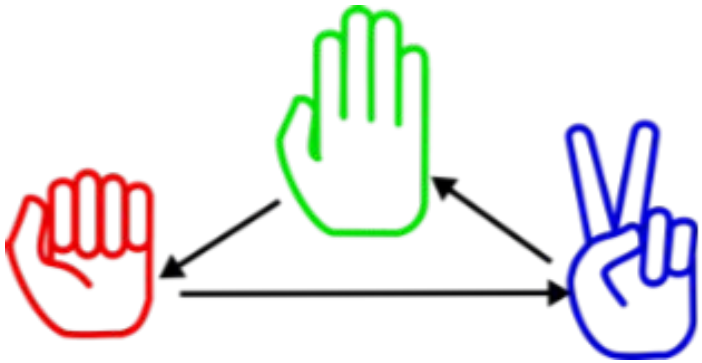
- Allocate a value to each skill
- Sum the values for each choice

	Armour	Weapon	Speed		Cost (neg)	
Jeep	Low(1)	Low(1)	High(3)	4	Low (4)	0
APC	Medium(3)	Low(2)	Medium(2)	7	Medium (7)	0
Tank	High(4)	High(6)	Low(1)	11	High (12)	-1

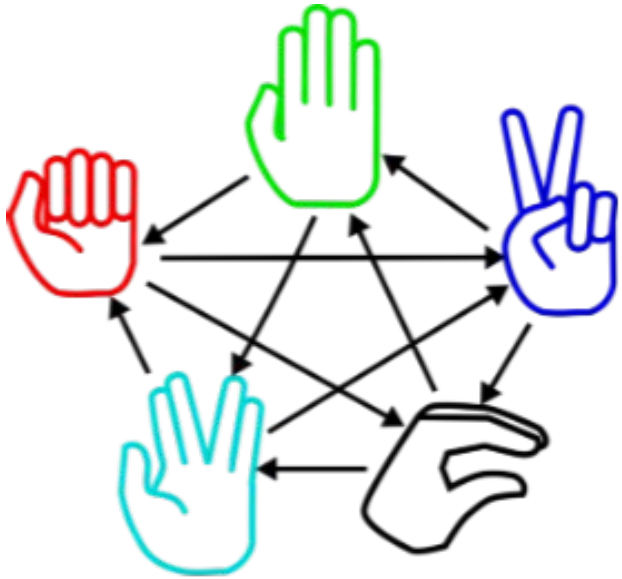
- Playtest
- Playtest
- Playtest

Rock Paper Scissors

	Rock	Paper	Scissors	sum
Rock	0 \ 0	0 \ 1	1 \ 0	1 \ 1
Paper	1 \ 0	0 \ 0	0 \ 1	1 \ 1
Scissors	0 \ 1	1 \ 0	0 \ 0	1 \ 1
sum	1 \ 1	1 \ 1	1 \ 1	3 \ 3



	Rock	Paper	Scissors	Lizard	Spock
Rock	0 \ 0	0 \ 1	1 \ 0	1 \ 0	0 \ 1
Paper	1 \ 0	0 \ 0	0 \ 1	0 \ 1	1 \ 0
Scissors	0 \ 1	1 \ 0	0 \ 0	1 \ 0	0 \ 1
Lizard	0 \ 1	1 \ 0	0 \ 1	0 \ 0	1 \ 0
Spock	1 \ 0	0 \ 1	1 \ 0	0 \ 1	0 \ 0



Rock Paper Scissor online

Against AI

https://www.afiniti.com/corporate/rock-paper-scissors

Against each other online

https://www.rpsgame.org/

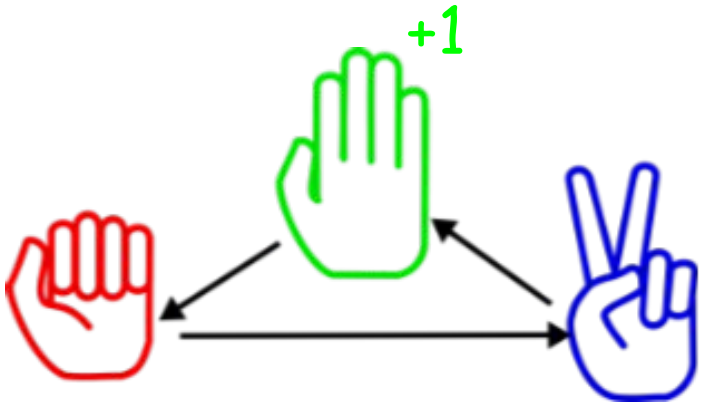
Play on discord

#rps channel on the discord server

Rock Paper Scissors

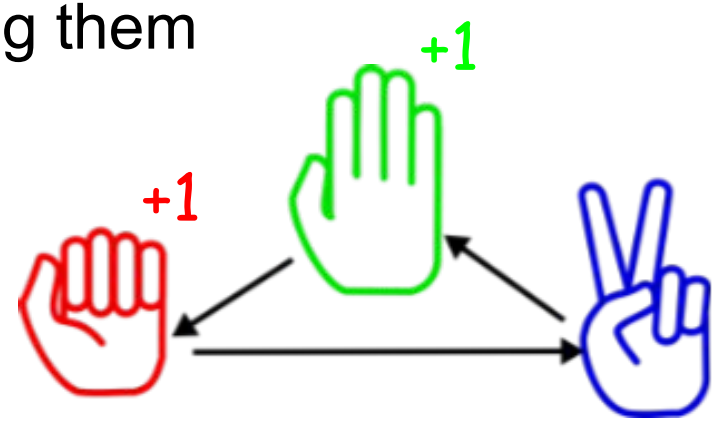
Paper gets +1 when you win using paper

	Rock	Paper	Scissors	sum
Rock	0 \ 0	0 \ 2	1 \ 0	1 \ 2
Paper	2 \ 0	0 \ 0	0 \ 1	2 \ 1
Scissors	0 \ 1	1 \ 0	0 \ 0	1 \ 1
sum	2 \ 1	1 \ 2	1 \ 1	4\4



Paper and Rock gets +1 when you win using them

	Rock	Paper	Scissors	sum
Rock	0 \ 0	0 \ 2	2 \ 0	2 \ 2
Paper	2 \ 0	0 \ 0	0 \ 1	2 \ 1
Scissors	0 \ 2	1 \ 0	0 \ 0	1 \ 2
sum	2 \ 2	1 \ 2	2 \ 1	5 \ 5



Mathematical Description

p1			p2	
R	8		R	2
P	1		P	2
S	1		S	2
adaption	10%		adaption	10%