Linear Programming for MOBA Strategy Video Games

Linear Programming
- Built-in MATLAB
  - linprog and intlinprog
- Simplex Method function
  - linprog
- Other Methods?

Data and Optimization Problems

Optimal

Results

Modeling and Optimization Techniques for MOBA Games
Linear Programming

- Built-In MATLAB
  - *linprog* and *intlinprog*
- Simplex Method function
  - *lpsimplex.m*
- Other Methods?

*Other Methods*
We looked into a multitude of other methods such as:
- Big M method
  - when a constraint has different inequality
- Dual Simplex Method
  - when a variable has a different inequality

But these didn’t fit what we needed from our optimization process so we used linprog, intlinprog and lpsimplex.
**Other Methods**

We looked into a multitude of other methods such as:

- **Big M method**
  - when a constraint has different inequality
- **Dual Simplex Method**
  - when a variable has a different inequality

But these didn't fit what we needed from our optimization process so we used linprog, intlinprog and lpsimplex
The Video Game

- Multiplayer Online Battle Arena (MOBA)
- League of Legends (LoL)
- Champions and Items

**Champions**
Champions Used in Project: We used 3 that are the best for beginning players.
- Ashe
- Garen
- Ryze

**Items**
We used 33 of the most common items in this project. Items can provide all manner of useful bonuses such as the 6 used in this project:
- Health
- Mana
- Attack Damage
- Armor
- Magic Resist
- Ability Power
**Champions**

Champions Used in Project
We used 3 that are the best for beginning players

• Ashe
• Garen
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**Items**

We used 33 of the most common items in this project. Items can provide all manner of useful bonuses such as the 6 used in this project:

- Health
- Mana
- Attack Damage
- Armor
- Magic Resist
- Ability Power
Visiting mobafire.com, a strategy guide tool for LoL, provided stats of the most popular "builds" for the 3 champions. The popular "builds" are seen to be the optimum build for each champion.

The problem we are trying to solve is to minimize the cost of the champions build subject to at least the same stats as the recommended builds from the site.

Then compare our builds to the site builds validating to optimum build or improving the build.
**Inputs**

The function takes inputs f, A, b

```python
champ = 'Ashe';
b = [800;0;220;60;130;0;6];

champ = 'Garen';
b = [2800;0;105;110;70;0;6];

champ = 'Ryze';
b = [1200;1050;0;90;70;380;6];
```

f is the cost of gold for each item which is final row of the data shown in the previous slide.

A is the remainder of the data which is stats of each item.
 Outputs
The outputs from our functions for all three characters.

**Ashe**
- **With stacking items**
  - 1' "Guardian Angel"
  - 2' "Mecurial Scimitar"
  - 1' "Phage"
  - 1' "Titanic Hydra"
  
  Total cost is 16400 gold.
- **Without stacking items**
  - 'Black Cleaver'
  - Guardian Angel'
  - Infinity Edge'
  - 'Last Whisper'
  - 'Mecurial Scimitar'
  - 'Spirit Visage'
  
  Total cost is 17800 gold.

**Garen**
- **With stacking items**
  - 1' "Black Cleaver"
  - 1' "Dead Man's Plate"
  - 1' "Spirit Visage"
  - 2' "Sunfire Cape"
  - 1' "Titanic Hydra"
  
  Total cost is 18100 gold.
- **Without stacking items**
  - 'Black Cleaver'
  - 'Dead Man's Plate'
  - 'Randuin's Omen'
  - 'Spirit Visage'
  - 'Sunfire Cape'
  - 'Titanic Hydra'
  
  Total cost is 18400 gold.

**Ryze**
- **With stacking items**
  - 2' "Moonflair Spellblade"
  - 4' "Rod of Ages"
  
  Total cost is 17000 gold.
- **Without stacking items**
  - 'Archangel's Staff'
  - 'Frozen Heart'
  - Rabarden's Deathcap'
  - 'Rod of Ages'
  - 'Rylai's Crystal Scepter'
  - 'Spirit Visage'
  
  Total cost is 18700 gold.
Ashe

With stacking items
'1' 'Guardian Angel'
'2' 'Mecurial Scimitar'
'2' 'Phage'
'1' 'Titanic Hydra'

Without stacking items
'Black Cleaver'
'Guardian Angel'
'Infinity Edge'
'Last Whispher'
'Mecurial Scimitar'
'Spirit Visage'

Total cost is 16400 gold.

Total cost is 17800 gold.
Garen

With stacking items:
- 1 'Black Cleaver'
- 1 'Dead Man's Plate'
- 1 'Spirit Visage'
- 2 'Sunfire Cape'
- 1 'Titanic Hydra'

Total cost is 18100 gold.

Without stacking items:
- 'Black Cleaver'
- 'Dead Man's Plate'
- 'Randuin's Omen'
- 'Spirit Visage'
- 'Sunfire Cape'
- 'Titanic Hydra'

Total cost is 18400 gold.
**Ryze**

With stacking items
- '2' 'Moonflair Spellblade'
- '4' 'Rod of Ages'

Total cost is 17000 gold.

Without stacking items
- 'Archangel's Staff'
- 'Frozen Heart'
- 'Rabadon's Deathcap'
- 'Rod of Ages'
- 'Rylai's Crystal Scepter'
- 'Spirit Visage'

Total cost is 18700 gold.
Results

**Ashe**
- Health: 800
- Mana: 0
- Attack Damage: 220
- Armor: 60
- Magic Resist: 130
- Ability Power: 0
- Total cost is 17900 gold.

**Garen**
- Health: 800
- Mana: 0
- Attack Damage: 105
- Armor: 110
- Magic Resist: 70
- Ability Power: 0
- Total cost is 18400 gold.

**Ryze**
- Health: 1200
- Mana: 1050
- Attack Damage: 0
- Armor: 90
- Magic Resist: 70
- Ability Power: 380
- Total cost is 18700 gold.
MOBAfire.com Suggestions

- Infinity Edge
- Guardian Angel
- The Bloodthirster
- Last Whisper
- The Black Clover
- Barbarian's Vail

Ashe

Health: 800
Mana: 0
Attack Damage: 220
Armor: 60
Magic Resist: 130
Ability Power: 0

Total cost is 17900 gold.

Matlab Optimization Result

- Infinity Edge
- Guardian Angel
- Spite Venge
- Last Whisper
- The Black Clover
- Mercurial Scimitar

Health: 800
Mana: 0
Attack Damage: 220
Armor: 60
Magic Resist: 165
Ability Power: 0

Total cost is 17800 gold.
MOBAfire.com Suggestions

Health: 800
Mana: 0
Attack Damage: 220
Armor: 60
Magic Resist: 130
Ability Power: 0

Total cost is 17900 gold.
Ashe

Matlab Optimization Result

Health: 800
Mana: 0
Attack Damage: 220
Armor: 60
Magic Resist: 165
Ability Power: 0

Total cost is 17800 gold.
Garen

MOBAfire.com Suggestions

- Health: 2800
- Mana: 0
- Attack Damage: 105
- Armor: 110
- Magic Resist: 70
- Ability Power: 0

Total cost is 18400 gold.

Matlab Optimization Result

- Health: 2800
- Mana: 0
- Attack Damage: 105
- Armor: 155
- Magic Resist: 70
- Ability Power: 0

Total cost is 18400 gold.
MOBAfire.com Suggestions

Health: 2800
Mana: 0
Attack Damage: 105
Armor: 110
Magic Resist: 70
Ability Power: 0

Total cost is 184000 gold.
Matlab Optimization Result

Health: 2800
Mana: 0
Attack Damage: 105
Armor: 155
Magic Resist: 70
Ability Power: 0

Total cost is 18400 gold.
300 gold.

MOBAfire.com Suggestions
- Health: 1200
- Mana: 1050
- Attack Damage: 0
- Armor: 90
- Magic Resist: 70
- Ability Power: 380
Total cost is 18700 gold.

Ryze

Matlab Optimization Result
- Health: 1200
- Mana: 1050
- Attack Damage: 0
- Armor: 90
- Magic Resist: 70
- Ability Power: 380
Total cost is 18700 gold.
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