Super Hero Match Up

These six heroes need to complete six tasks. So that no-one feels left out – and so that all the tasks get completed – there should be one task per hero. However, not every hero is suitable for every task. Your job is to find a combination that works.

The heroes:

Wolverine aka Logan	**Spiderman** aka Peter Parker	**Thor** aka God of Thunder
		
A mutant who can recover from pretty much any injury, and his adamantium skeleton (which occasionally protrudes in unnerving claws) makes him an even more deadly opponent face-to-face.	A boy who got bitten by a spider and now can't stop spinning webs from his wrists and saving people with his super-fast reflexes and spider-like combat abilities (which include jumping and walking on the ceiling.)	A being from another planet who, in addition to being able to fly, can control the weather, is pretty much immune to injury and is very dangerous one-on-one with (or without) a hammer.

The Hulk aka Bruce Banner	**Captain America** aka Steve Rogers	**Iron Man** aka Tony Stark
		
A brilliant mind trapped, when the mood takes him, in a huge green body. Unmatched scientific brilliance meets practically indestructible physique. No jar too tight.	An artificially enhanced soldier. His reflexes, strength, endurance and hand-to-hand combat are fearsome. Once he just chilled in a block of ice for years. And he has a cool shield.	A brilliant – if somewhat cocky – mathematical and scientific genius who weaponised a metal suit which enables him to shoot lasers from his hands. And fly. Even in space.

The tasks:

Beat Agent Smith	**Defuse Godzilla**	**Catch Toothless**
		
Beat Agent Smith (from The Matrix) in unarmed hand-to-hand combat.	Remove highly radioactive material from nuclear test sites before Godzilla (from Godzilla) reawakens.	Intercept Toothless (from How to Train Your Dragon) in mid-air.

Destroy the Ring	**Hack Skynet**	**Stop Elsa**
		
Destroy the One Ring (from Lord of the Rings) by dropping it straight into the Sun.	Reprogram Skynet (from The Terminator) by solving a fiendish system of differential equations.	Stop Princess Elsa (from Frozen) from destroying the world, using only one hand (she'll probably freeze you before you can attack).

1. Draw a diagram to represent all possible matchings between heroes and tasks.

2. Find a complete matching between heroes and tasks, using any method.

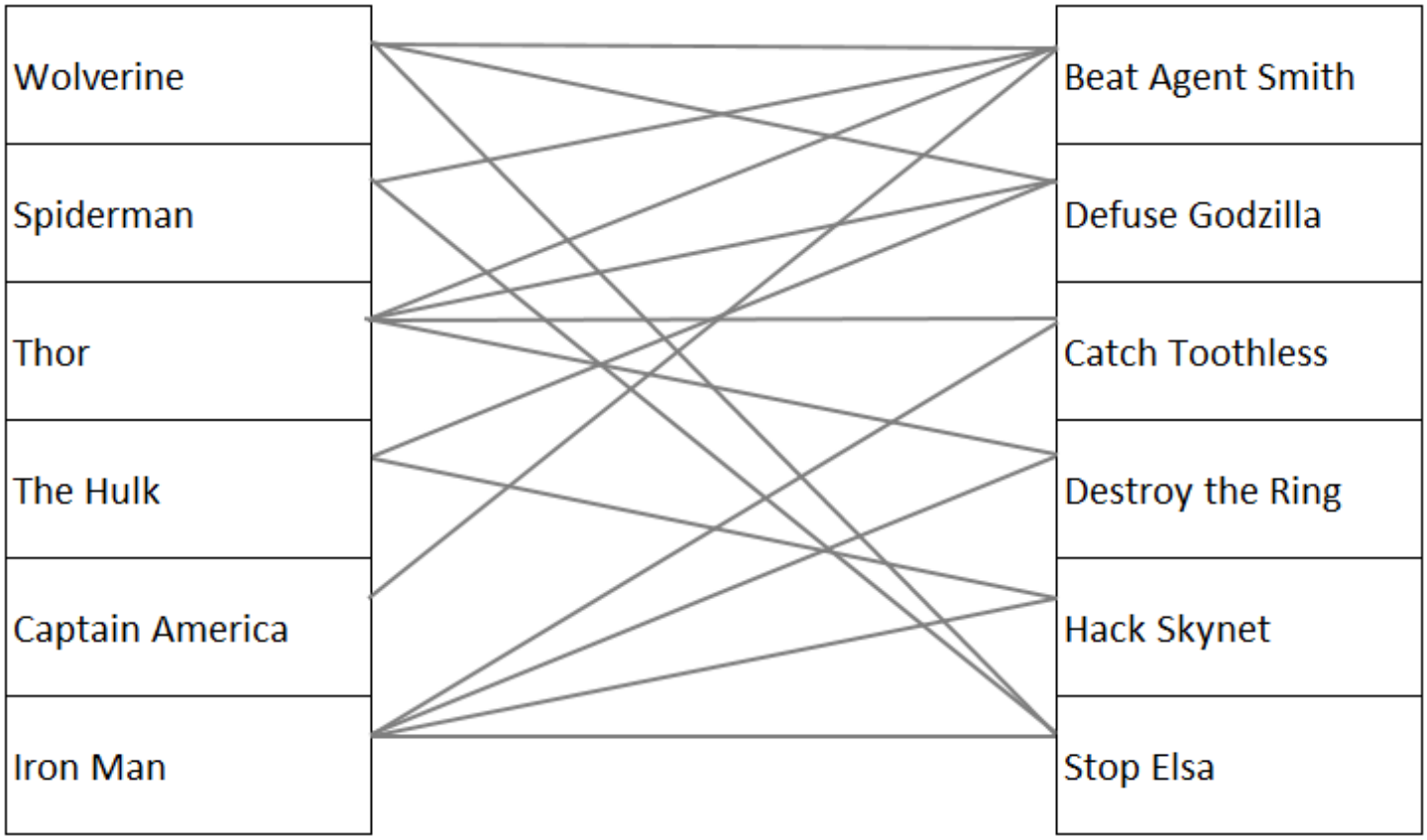
3. Are there any other complete matchings?
If you have found them all, can you prove that there are no more?

4. Can you come up with a systematic method that will always find a complete matching if there is one? Hint: start with a diagram, and an incomplete matching.

Super Hero Match Up SOLUTIONS

1. Possible diagrams include a bipartite graph and an adjacency matrix.

Bipartite graph:

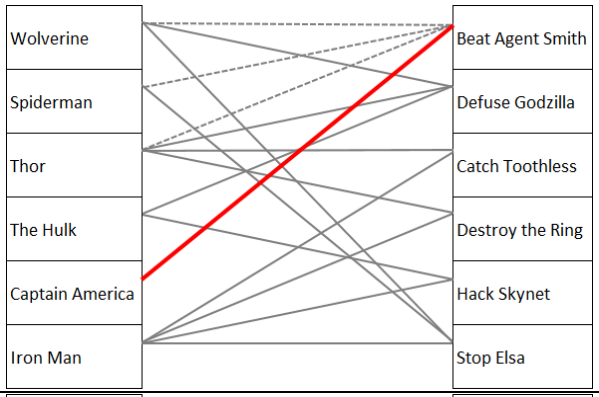


Adjacency Matrix:

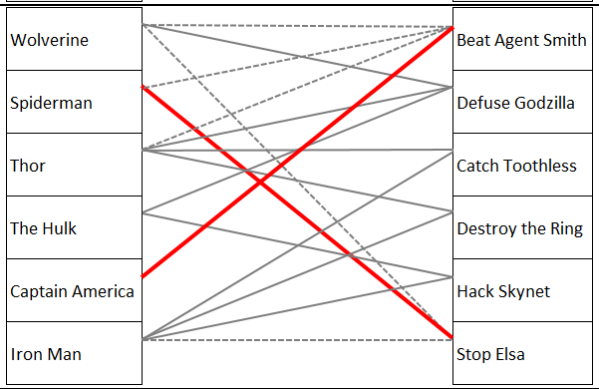
	Beat Agent Smith	Defuse Godzilla	Catch Toothless	Destroy the Ring	Hack Skynet	Stop Elsa
Wolverine	**1**	**1**	0	0	0	**1**
Spiderman	**1**	0	0	0	0	**1**
Thor	**1**	**1**	**1**	**1**	0	0
The Hulk	0	**1**	0	0	**1**	0
Captain America	**1**	0	0	0	0	0
Iron Man	0	0	**1**	**1**	**1**	**1**

2, 3.

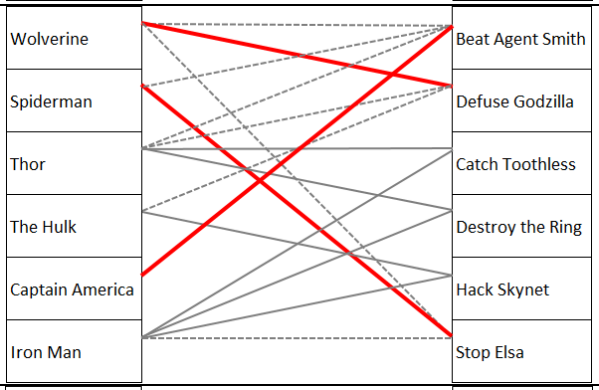
Any complete matching must have Captain America facing Agent Smith, since that is the only task he can complete.
This means no-one else can take that task.



The effect of deleting matchings leaves Spiderman with only one option, so he is given the task of stopping Elsa.

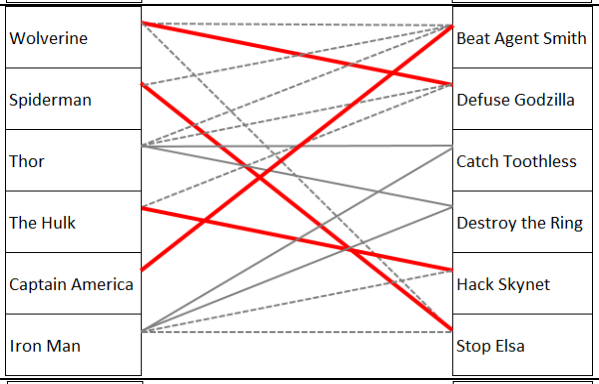


Wolverine now only has one choice: Defuse Godzilla.

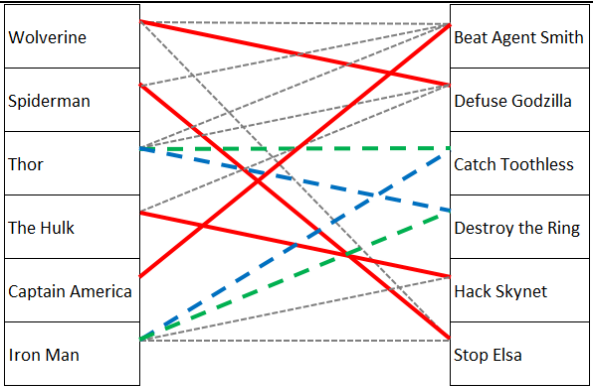


And since The Hulk's invincibility isn't needed, the only other thing he's good for is maths. So The Hulk (or, more probably, Bruce Banner) hacks Skynet.

So far we have had no free choices. If a complete matching exists, it starts like this.



It is clear that, at this stage, either of the two possibilities will yield a complete matching, so either Thor chases the dragon while Iron Man destroys the one ring, or vice versa. Of course, not being hobbits, I it's doubtful that either of them would be able to resist the power of the one ring…



4. For a systematic method, look up the **Alternating Path Algorithm**.