

By the end of
this section

What is a Strategic game?

What is Game Theory?

How do we classify games?

A man in a dark suit stands on a cracked, brown, textured surface, looking up at a large, curved Earth. The Earth is shown from a low angle, appearing as a massive, blue and green planet against a dark background with stars. A bright blue ring surrounds the planet.

“No man is an island”
-John Donne

**Everyday, we're involved in a
myriad of interactive situations**



Parents





Siblings

Bosses



Colleagues



Decision making in
interactive situations



Decision making
in isolation

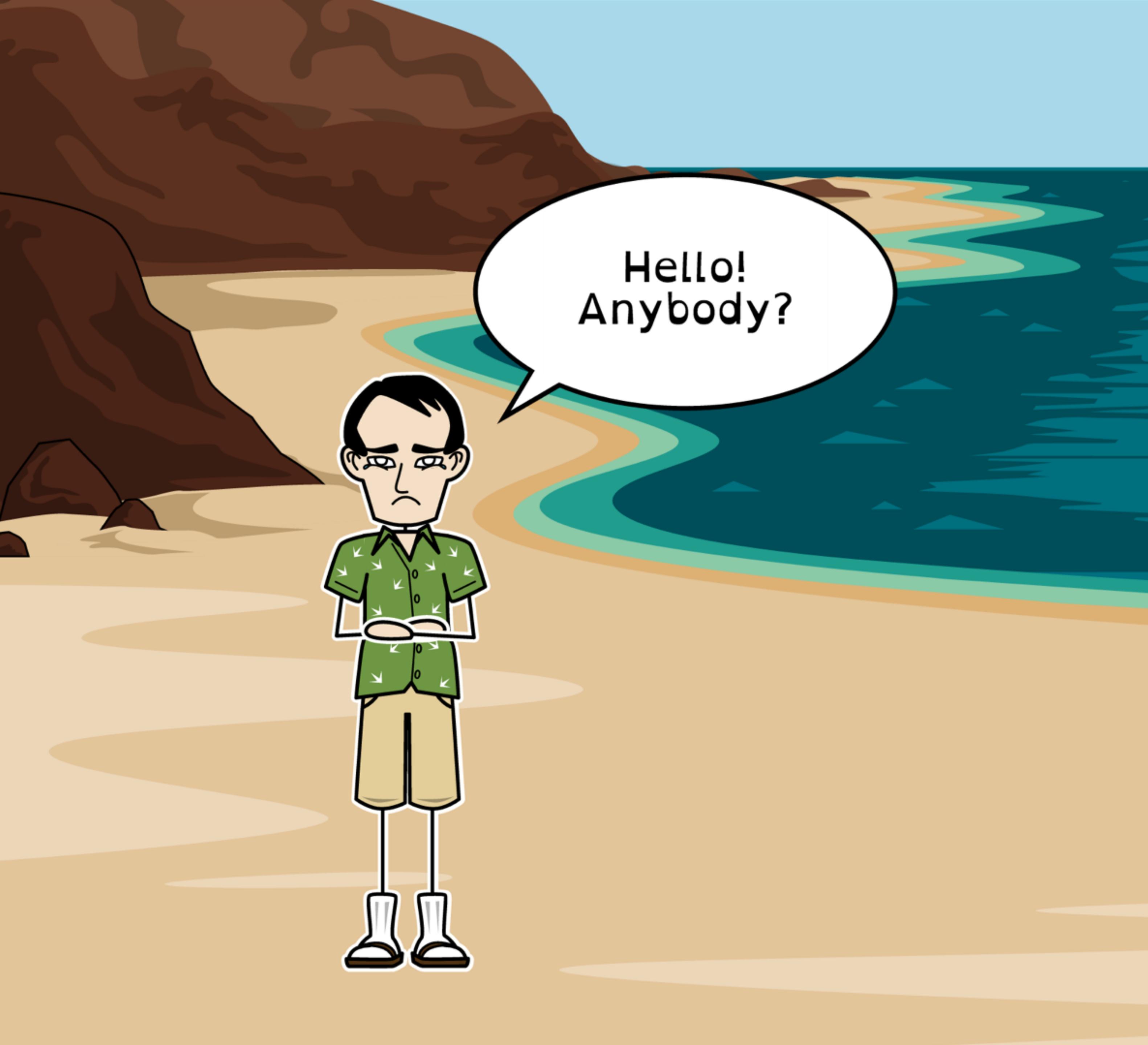


Decision making in
interactive situations

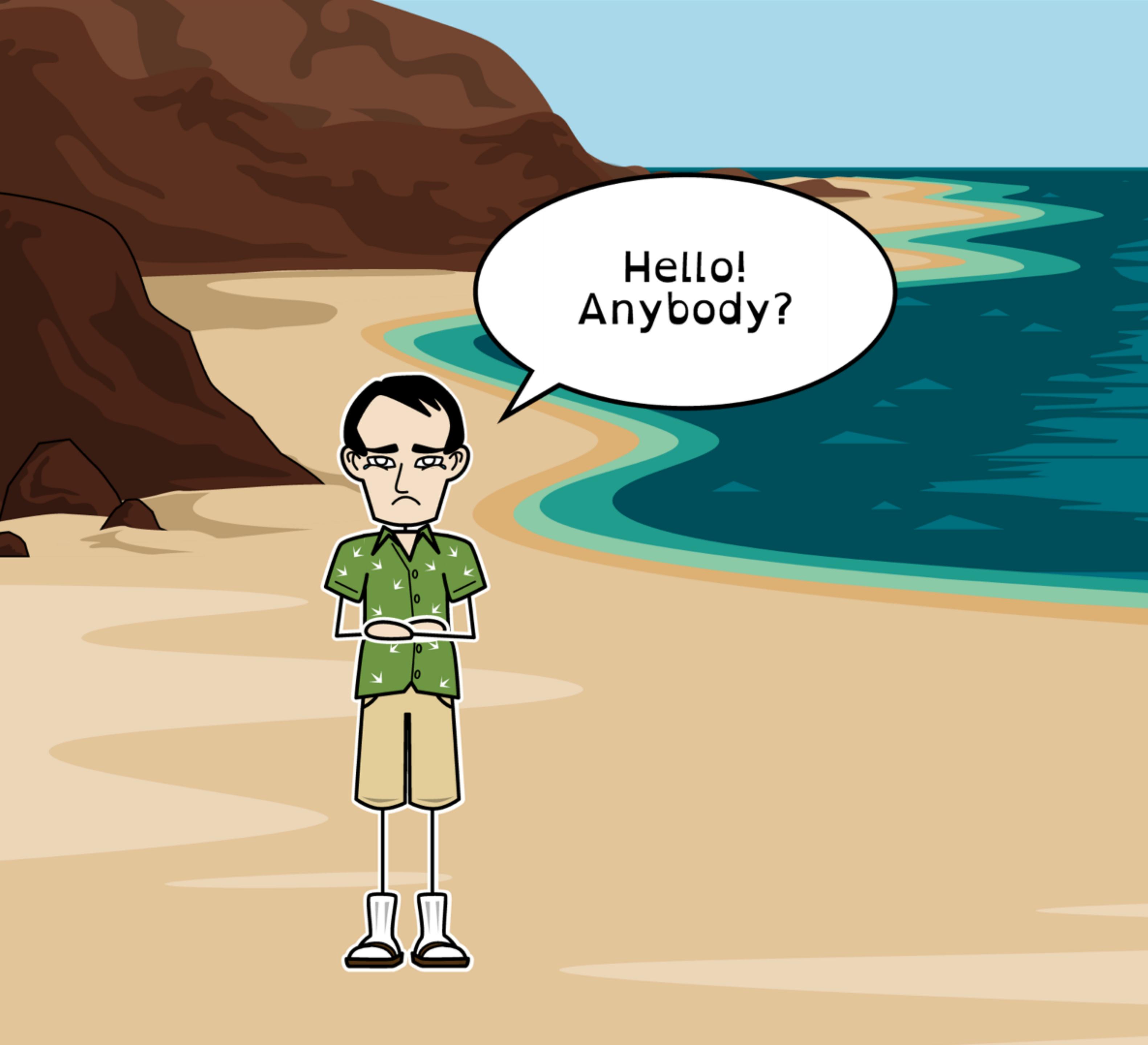


Decision making
in isolation

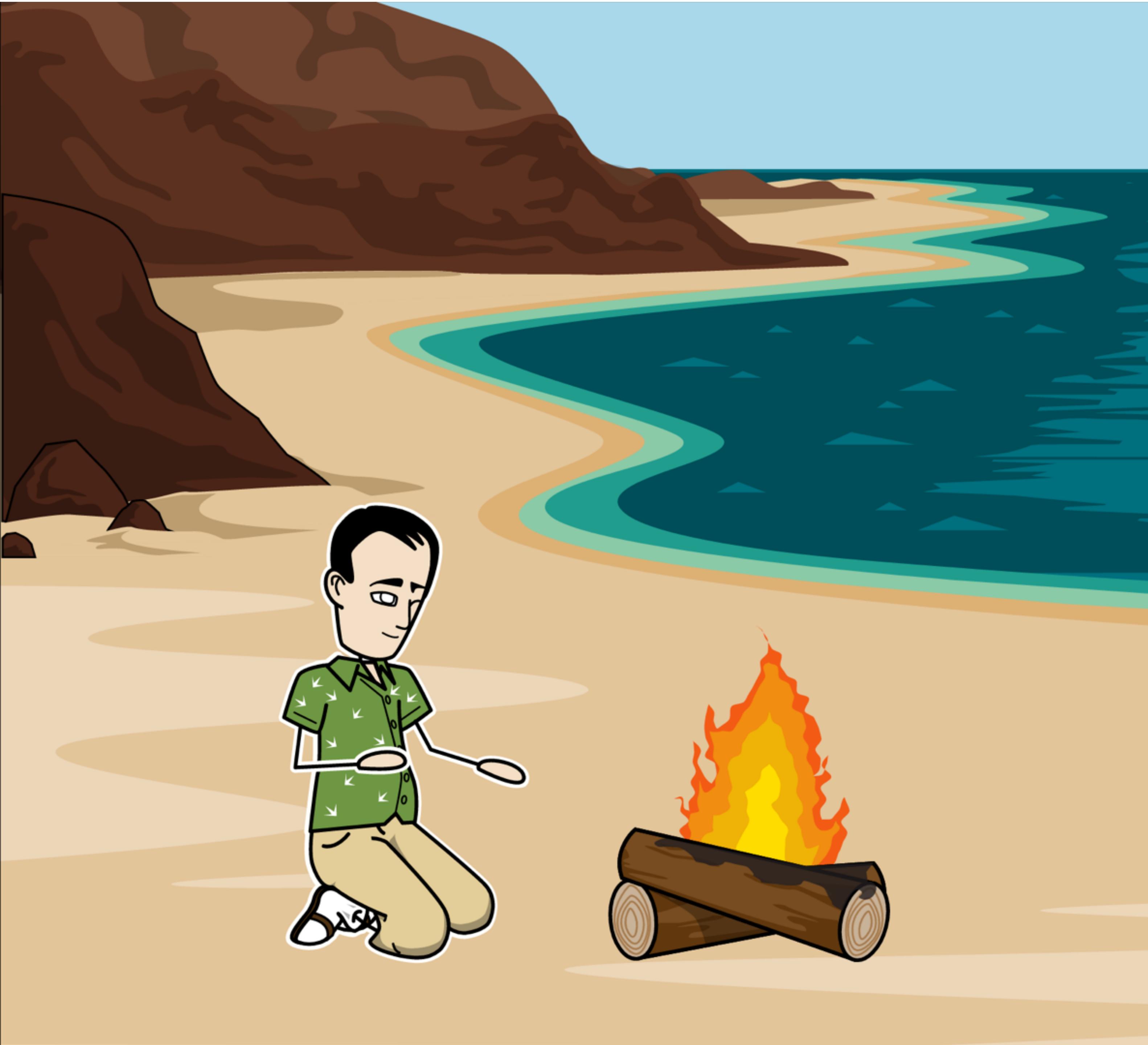




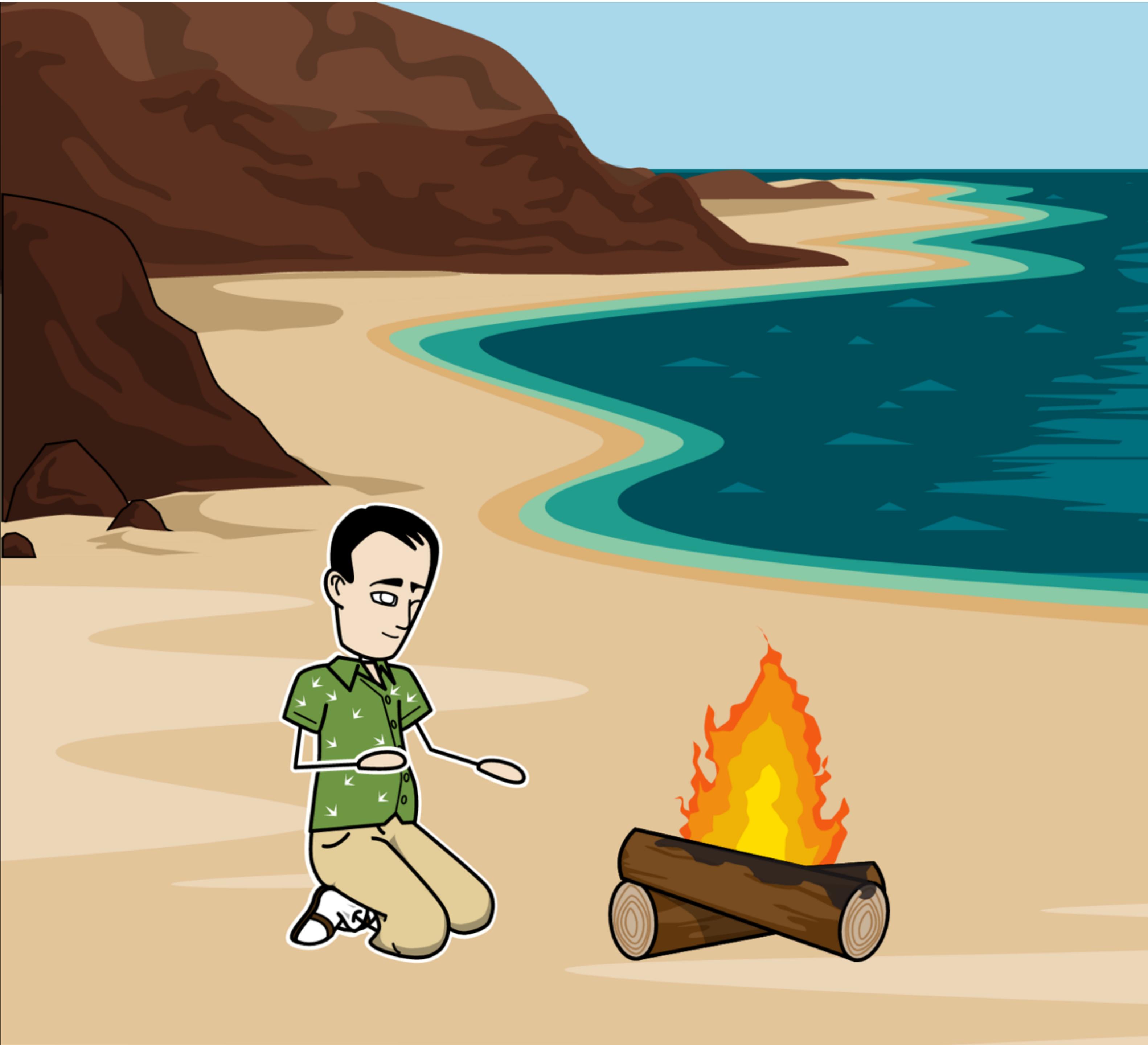
Say you're stranded
on a deserted island



Your goal is to
survive the cold
night



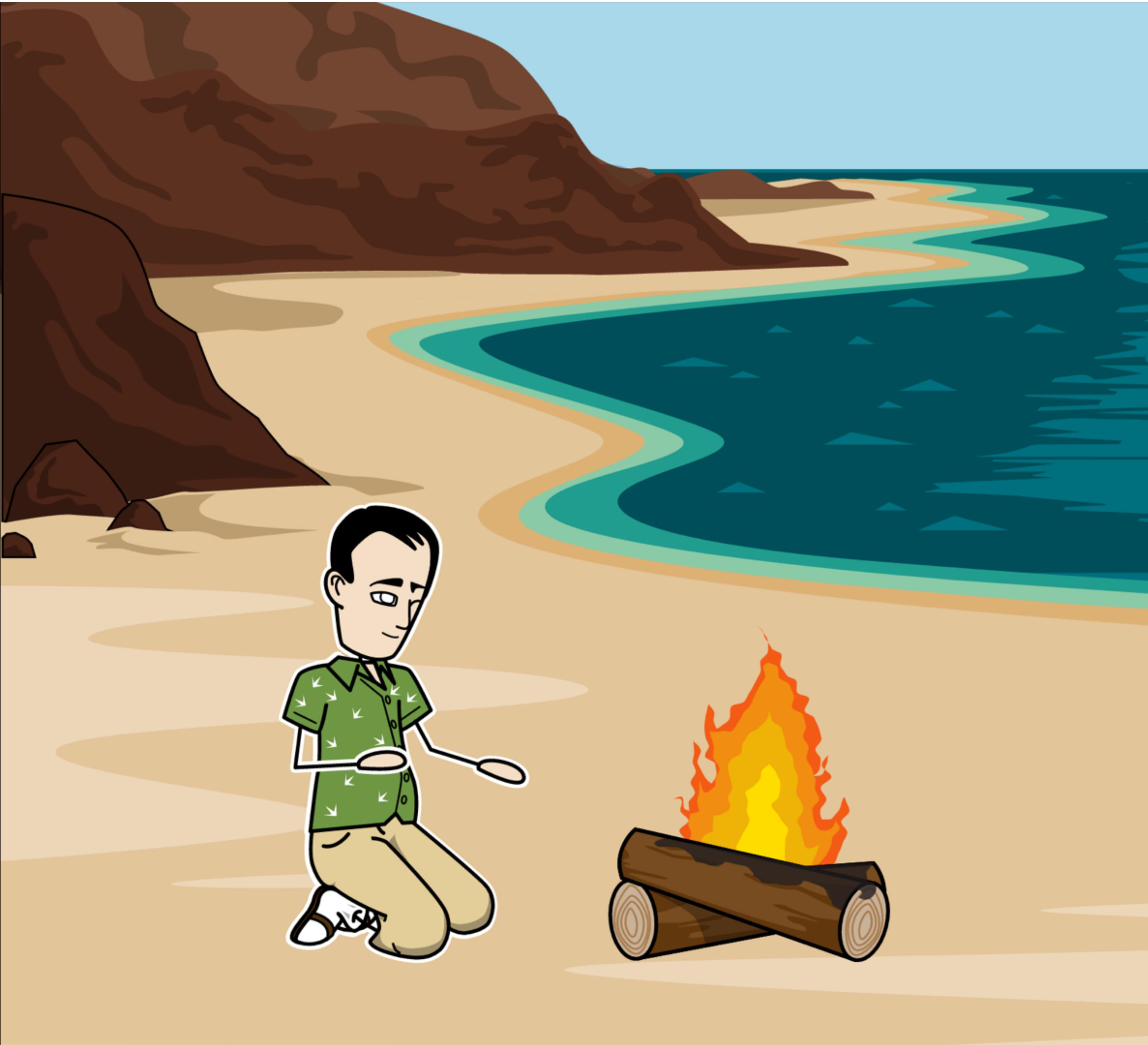
You decide to
make a fire



You need to
make a series of
small decisions

What materials?

How will you
generate sparks?

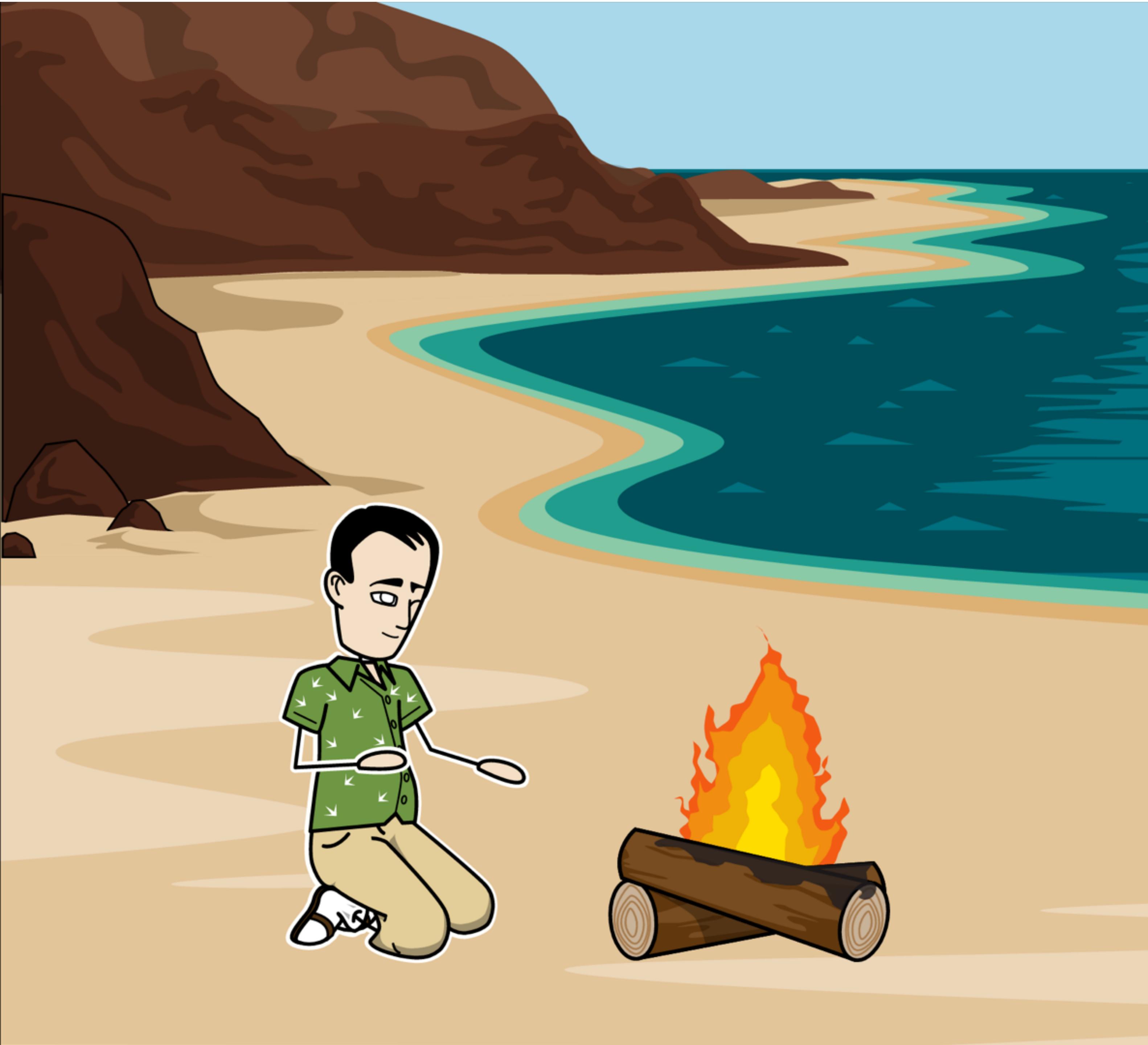


The agents you
interact with

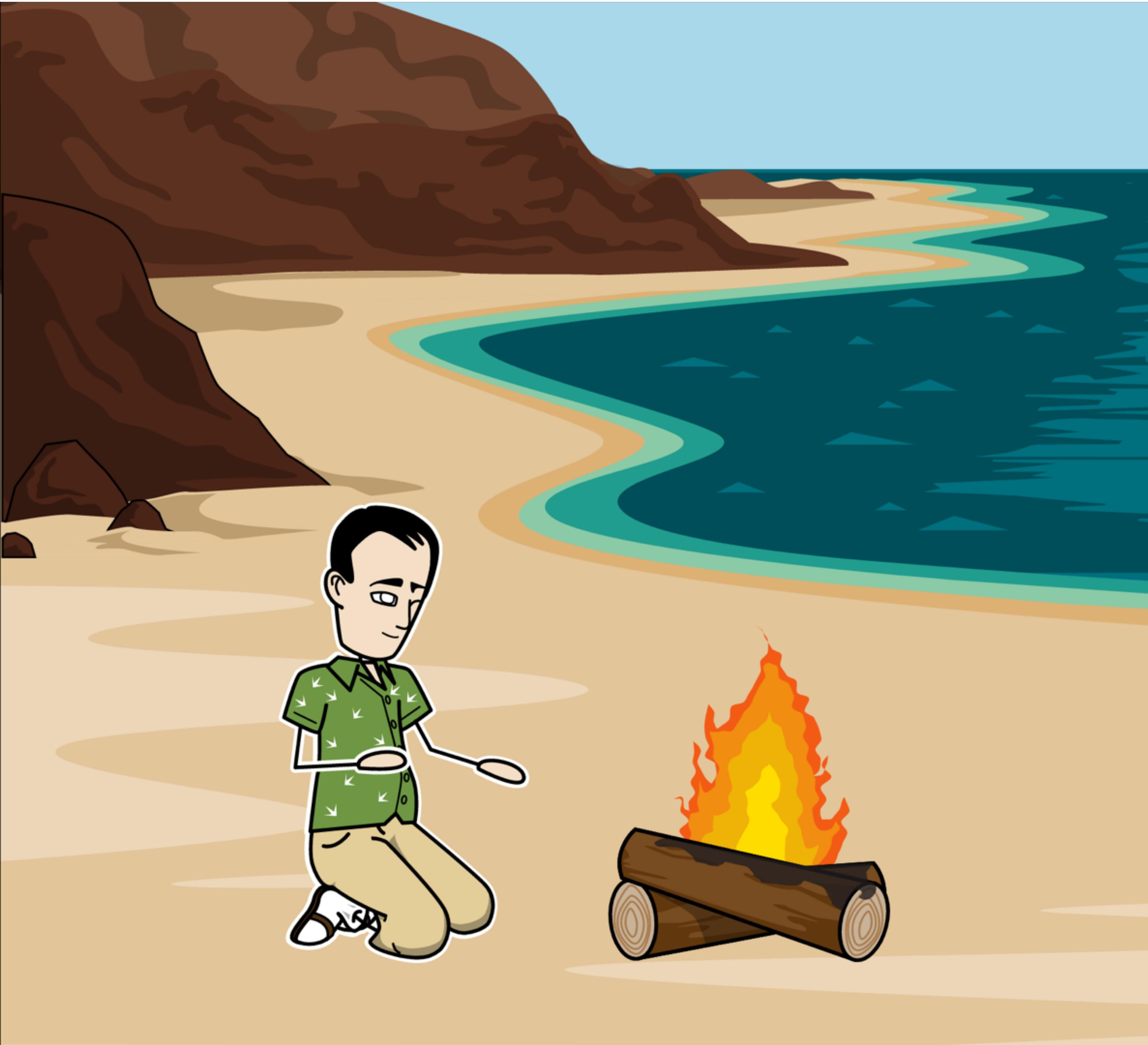
Flint

Kindling

Wood



These are
inanimate
Flint
Kindling
Wood



Flint
Kindling
Wood

They don't
have their
own goals/
intentions

Decision making in
interactive situations



Decision making
in isolation



Decision making in interactive situations



Decision making in isolation



Strategic Game

1. Interactive thinking

2. Maximizing utility

Let's see some more
examples to understand



What if there
was a prior
inhabitant on
the island?



Her goal is to protect the island and to kill any intruders



The fire would
give away
your location



Before taking
any action you
need to consider
her reactions



**Before you make
any decision**

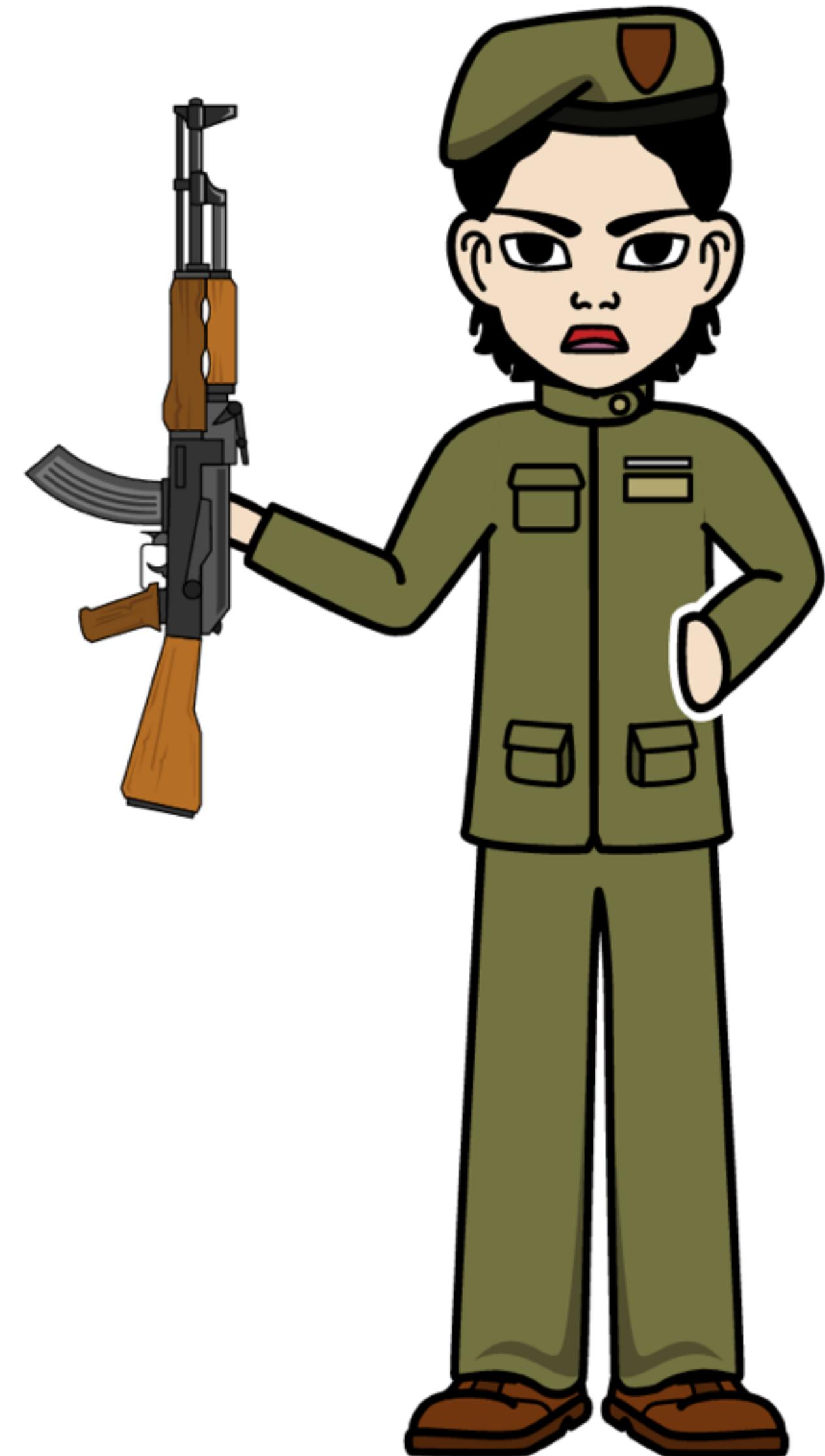
**Consider what
your opponent's
reaction will be**

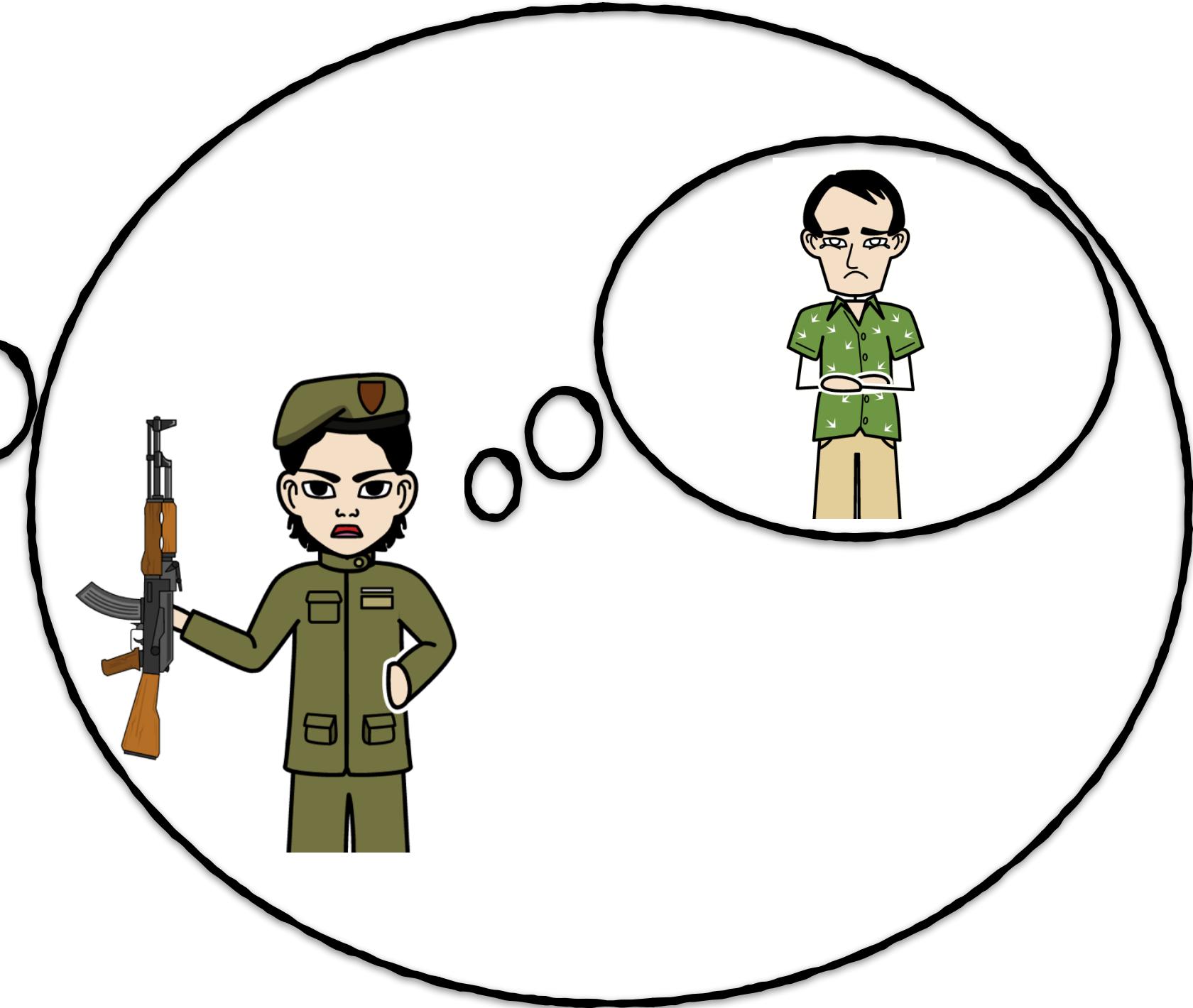




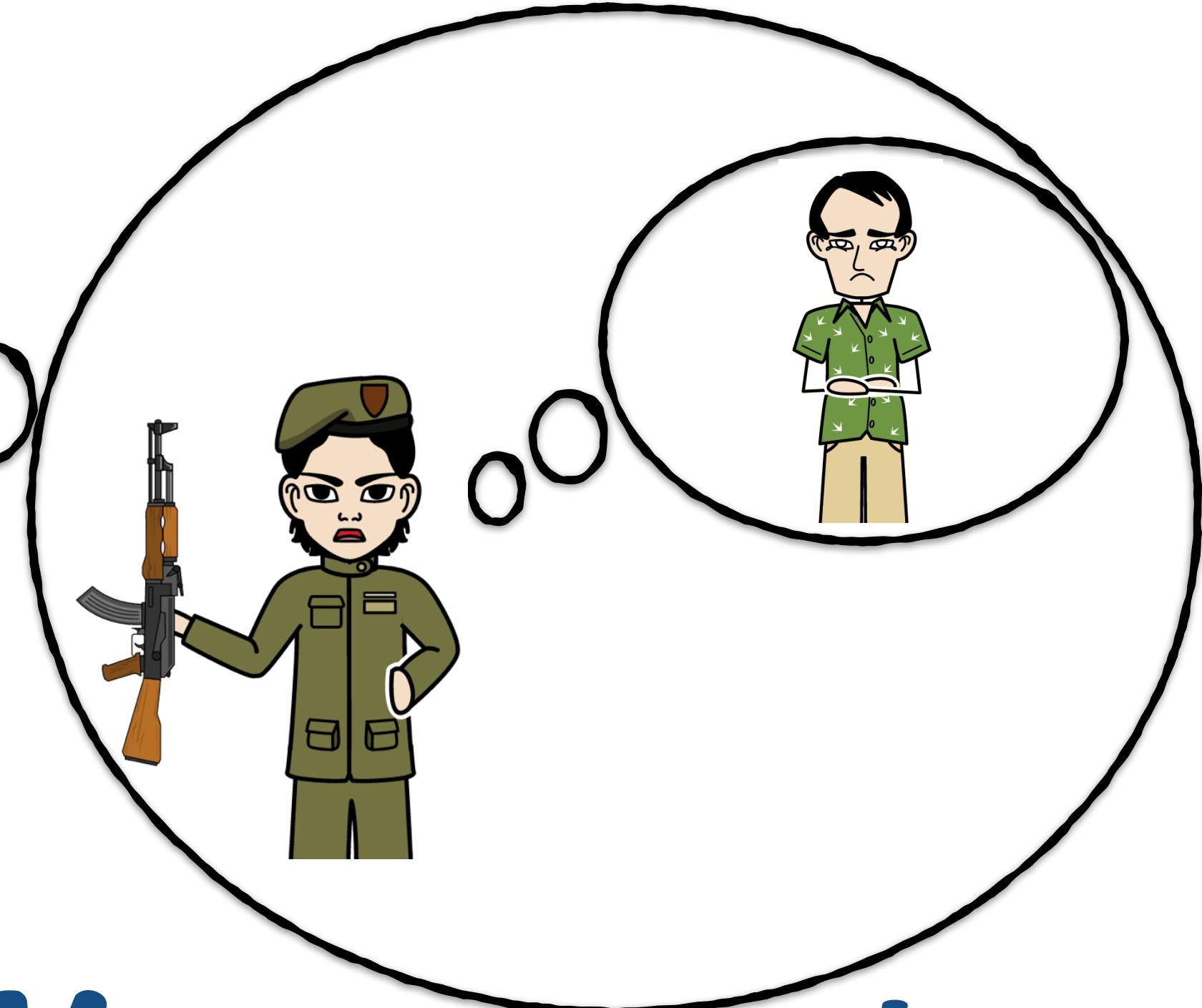
Your opponent will
try to anticipate
your decision

Consider what
your opponent will
expect from you



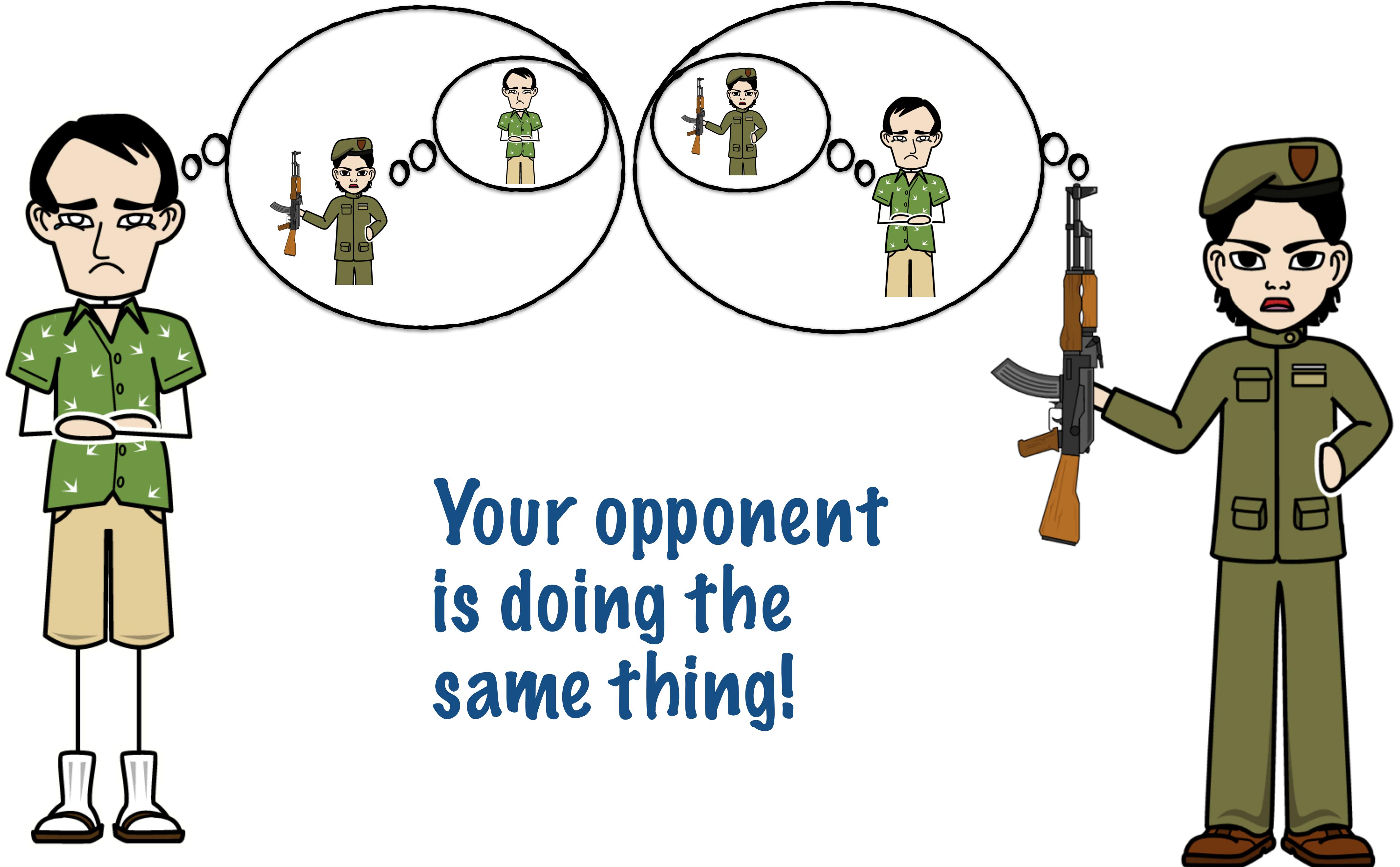


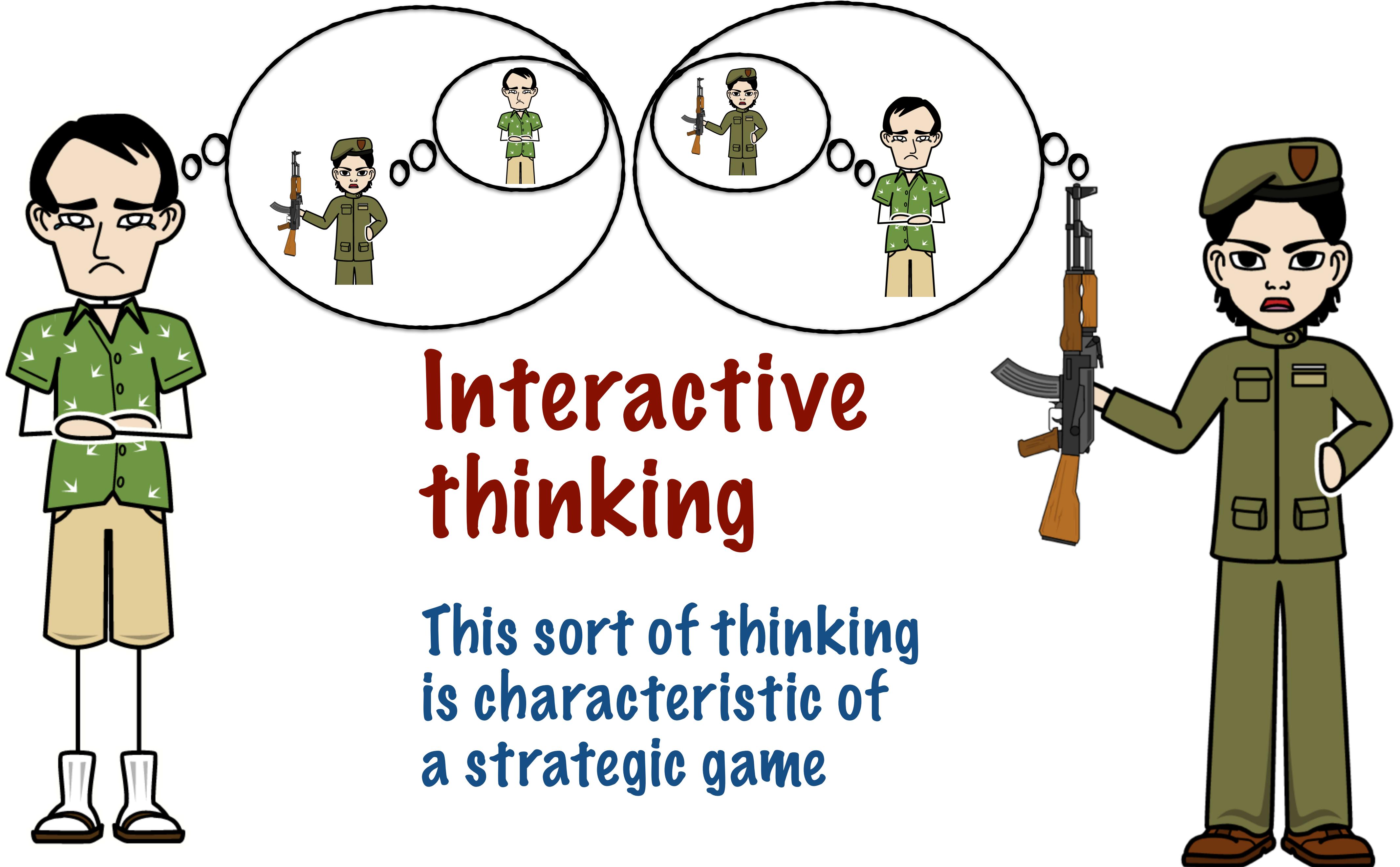
Consider what
your opponent will
expect from you



You are trying to
think through all
the consequences of
your actions







Interactive thinking

This sort of thinking
is characteristic of
a strategic game





Strategic game
Interactive thinking
is a key aspect of
strategic games



Survive!



**In a Strategic
Game**

**All players involved
have their own
goals/intentions**

Kill!





Any decision you
make will lead to

Benefits which help
with your goal

Costs due to the
opponent's reaction





Maximizing Utility

In general, players would like to maximize benefits and minimize costs



Strategic Game

1. Interactive thinking

2. Maximizing utility

Westley and
Vizzini have a
Battle of Wits

In the movie, Princess Bride



Westley's added poison to one of the goblets



Vizzini needs to choose a goblet to drink from





Strategic Game

1. Interactive thinking

Interactive thinking
has some pitfalls

2. Maximizing utility

Strategic Game

1. Interactive thinking

If not careful, you can
end up thinking in
circles, leading to
complete paralysis

2. Maximizing Utility

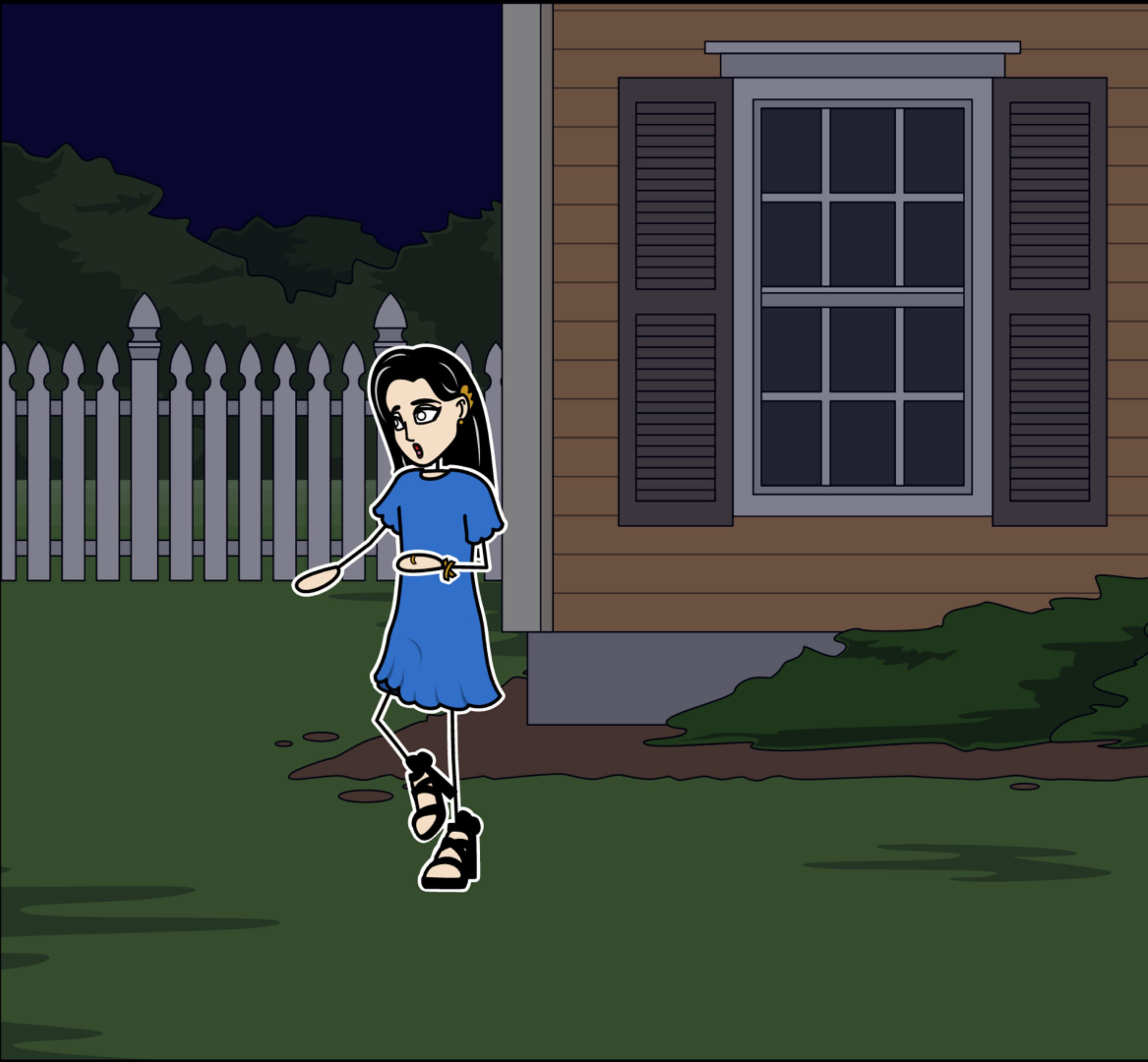
Strategic Game

1. Interactive thinking

2. Maximizing utility



A kid sneaking
out at night



Benefit = The thrill

Cost = The punishment if caught



If the thrill is
more important
and the likelihood
of being caught is
low

She will
sneak out

Strategic Game

1. Interactive thinking
2. Maximizing utility

Strategic Game

Many of our social interactions are strategic games

Parents, Siblings,
Bosses, Colleagues,
Friends, Rivals





Strategic Game

Consciously (or) Sub-consciously

We consider their
motivations and
reactions before we act



Game Theory

A scientific framework around
interactive decision making where
players act to maximize some utility

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A scientific framework around
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players act to maximize some utility

Game = interactive decision making

- Social interactions
- Political interactions
- Sports
- Military interactions

And many more



Game Theory

A scientific framework around
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Game Theory

A scientific framework around
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players act to maximize some utility

Theory

= A scientific framework

- Represent any situation as a mathematical model
- A framework for reasoning through any given situation



Game Theory

A scientific framework around
interactive decision making where
players act to maximize some utility

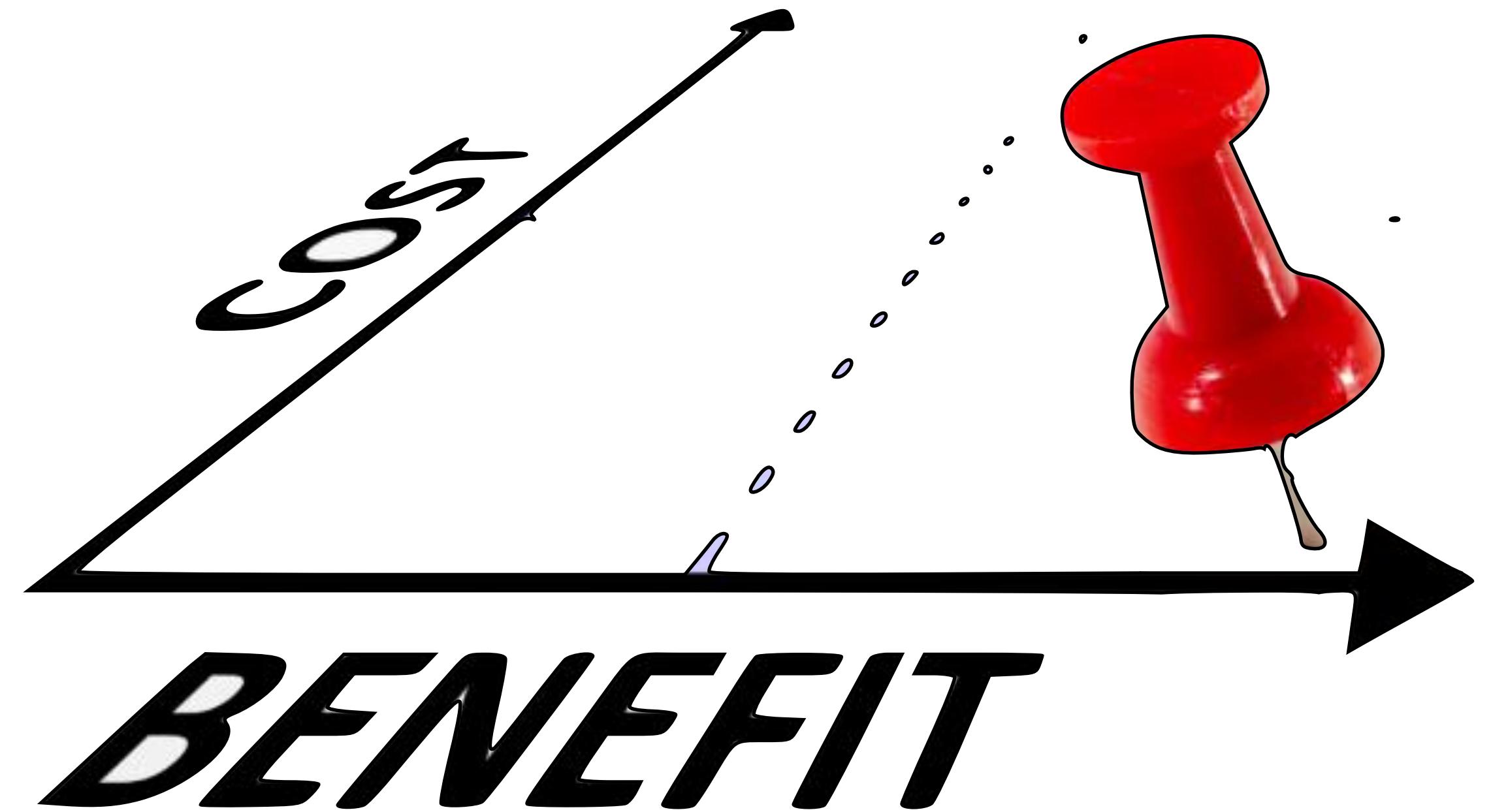
Game Theory

A scientific framework around
interactive decision making where
players act to **maximize some utility**

maximize some utility

Depends on what's important to the players

- Financial gain
- Winning a game
- GPA
- Power
- Emotional satisfaction



Game Theory

A scientific framework around
interactive decision making where
players act to **maximize some utility**

Game Theory

A scientific framework around
interactive decision making where
players act to maximize some utility

How can we classify games?

How can we classify games?

Do the players make their moves one after another or simultaneously?

Sequential vs Simultaneous

How can we classify games?

Sequential vs Simultaneous

Are the players in full conflict or do they have some common interests?

Zero-sum vs Non-zero-sum

How can we classify games?

Sequential vs Simultaneous

Zero-sum vs Non-zero-sum

Is it possible for the players to
reach an enforceable agreement?

Cooperative vs Non-
cooperative

How can we classify games?

Sequential vs Simultaneous

Zero-sum vs Non-zero-sum

Cooperative vs Non-cooperative

Is the game played just once
or is it repeated?

Repeated vs One-shot

How can we classify games?

Sequential vs Simultaneous

Zero-sum vs Non-zero-sum

Cooperative vs Non-cooperative

Repeated vs One-shot

Do all the players have the
same information?

Asymmetric vs Symmetric Information

How can we classify games?

Sequential vs Simultaneous

Zero-sum vs Non-zero-sum

Asymmetric vs Symmetric

Information

Cooperative vs Non-cooperative

Repeated vs One-shot

Are the rules fixed or
manipulable by the players?

Fixed vs Manipulable rules

How can we classify games?

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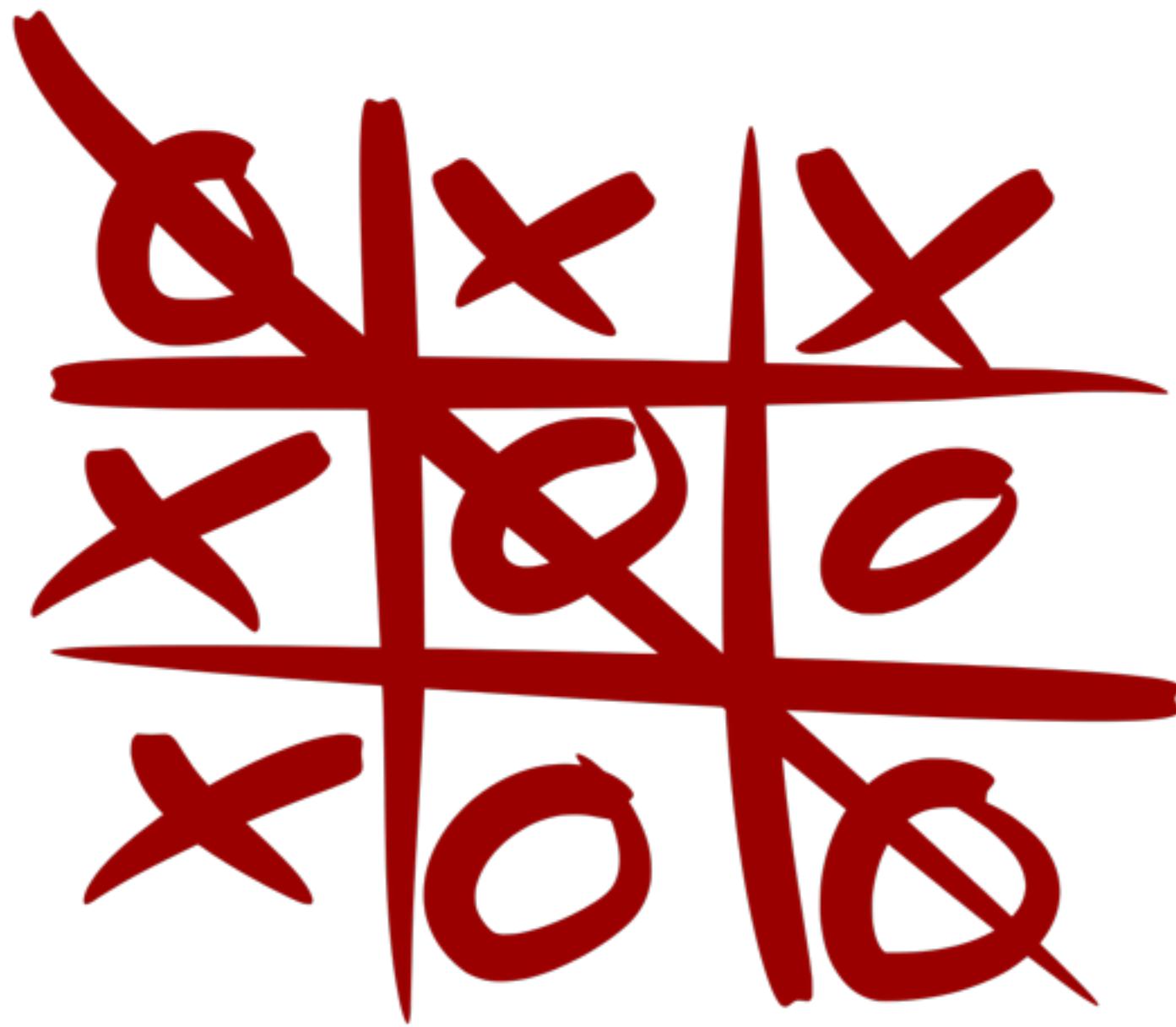
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Tic-Tac-Toe



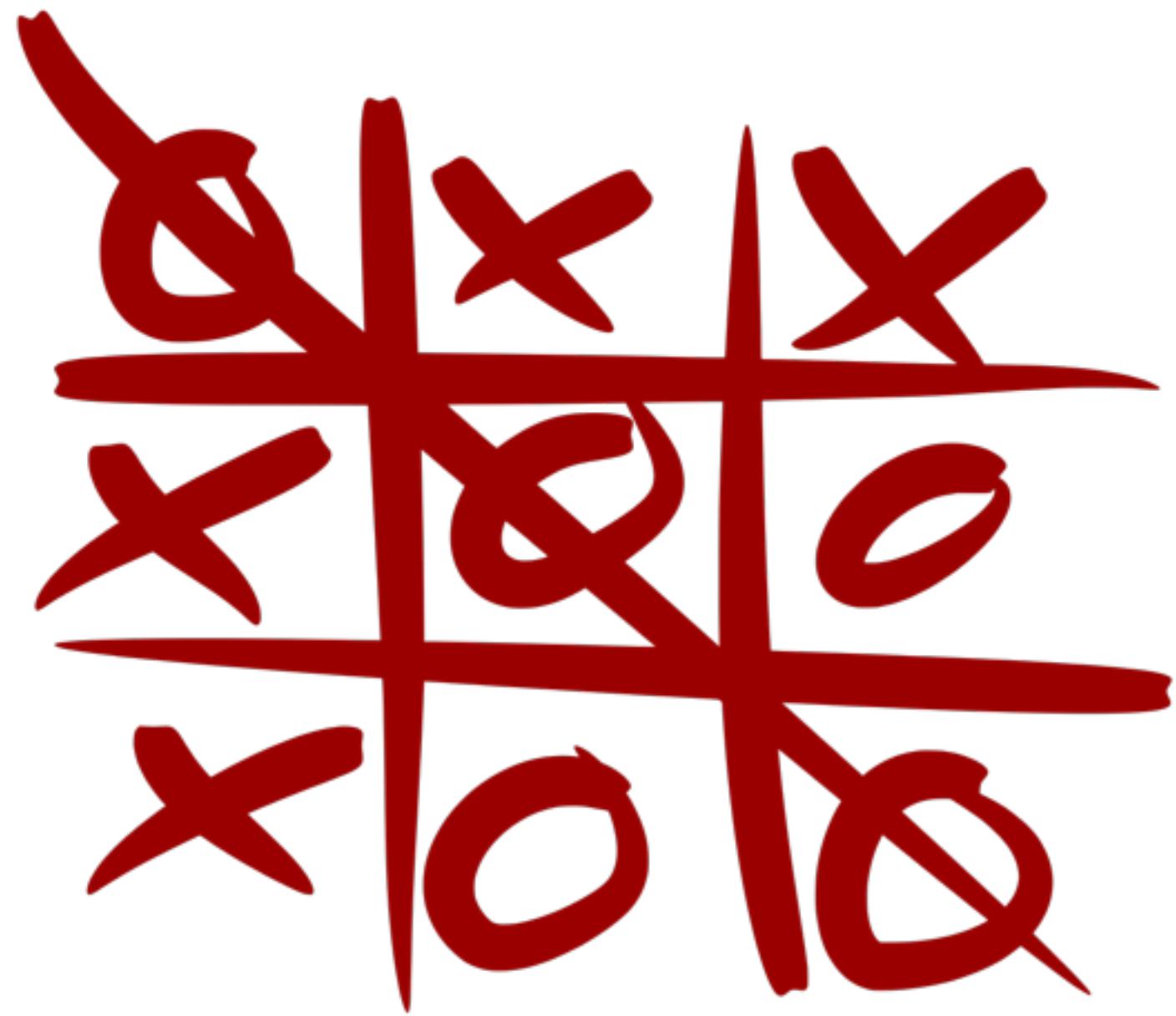
Players make their moves one after another

Rock-Paper-Scissors



Players make their moves at the same time

Tic-Tac-Toe



Sequential

Rock-Paper-Scissors



Simultaneous

Sequential

Chess

An art auction

Simultaneous

Football

Placing sealed bids
for a contract

Sequential

The player needs to consider what the next player will do in reaction

Consider what your opponent will think
in the future

Simultaneous

Consider what your opponent is thinking
right now

Sequential and Simultaneous

Some games might
be a mix of both

Sequential and Simultaneous

Two companies are launching competing products into the market around the same time



Sequential and Simultaneous

Before launch, each company is trying to consider what the opponent is planning

Design

Regions to launch in

Price



Sequential and Simultaneous

After launch, each company will make some move, and the other company will react

A price drop by 1 company will likely lead to some reaction by the other company



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Poker



One player's gain is
another player's loss

Zero-sum

Zero-sum

Gains among players
are offset by losses
of other players

Chess, football,
tennis and other
sports

Gambling games

Zero-sum

In Zero-sum games,
there are clear winners
and losers



There is no common
ground or shared interest

Constant-sum

Some games involve
dividing a fixed set
of gains among the
players



Non-zero sum

Most economic and social games have room for all players to gain something



Non-zero sum

Trade deals, Joint ventures

The players cooperate and compromise, so everyone can win to some extent



Non-zero sum

Some games can be
lose-lose for all

An extreme example
is Nuclear strikes



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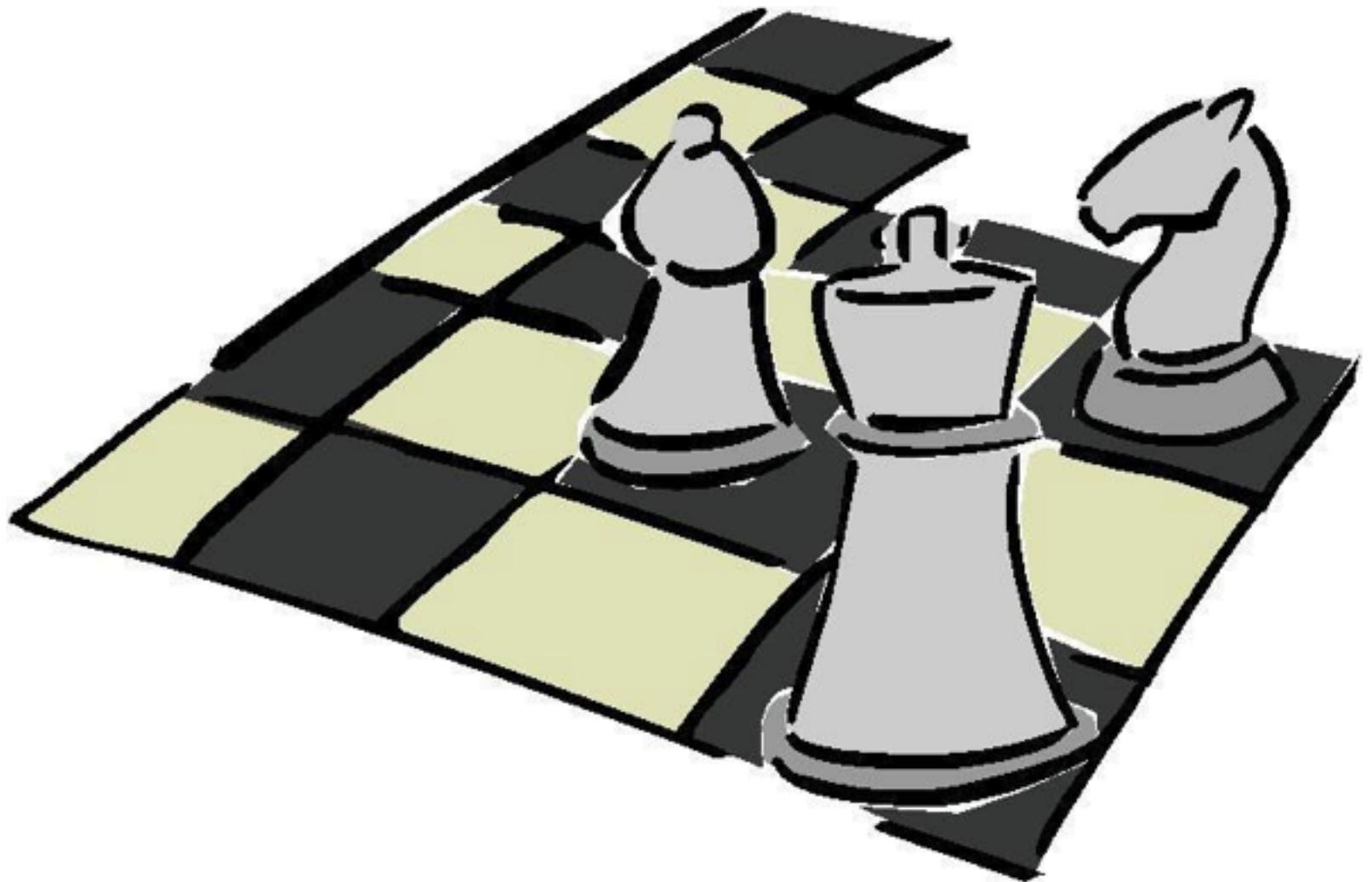
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Chess



All players have all
the information all
the time

Perfect and Symmetric
information

In a sailing
race



All players have the
same information

But, the players don't have
all the relevant
information

In a sailing
race



There is some uncertainty
due to external
circumstances like weather

Imperfect and
Symmetric
information

Card games



All players don't have
the same
information

Asymmetric
information

Card games



Each player will try to

Conceal the
information they have

Mislead others about the
information they have

Card games



Other players try to

Interpret the
information from
the actions of the
other player

When 2 people are dating,
they are trying to figure out

How much to reveal about
themselves?

How to present themselves
in the best light?

How not to put themselves
in a vulnerable position?

Dating



Dating

Each person is trying
to interpret the signals
from the other person



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Cooperative vs Non-cooperative

In every game, players have their goals and interests



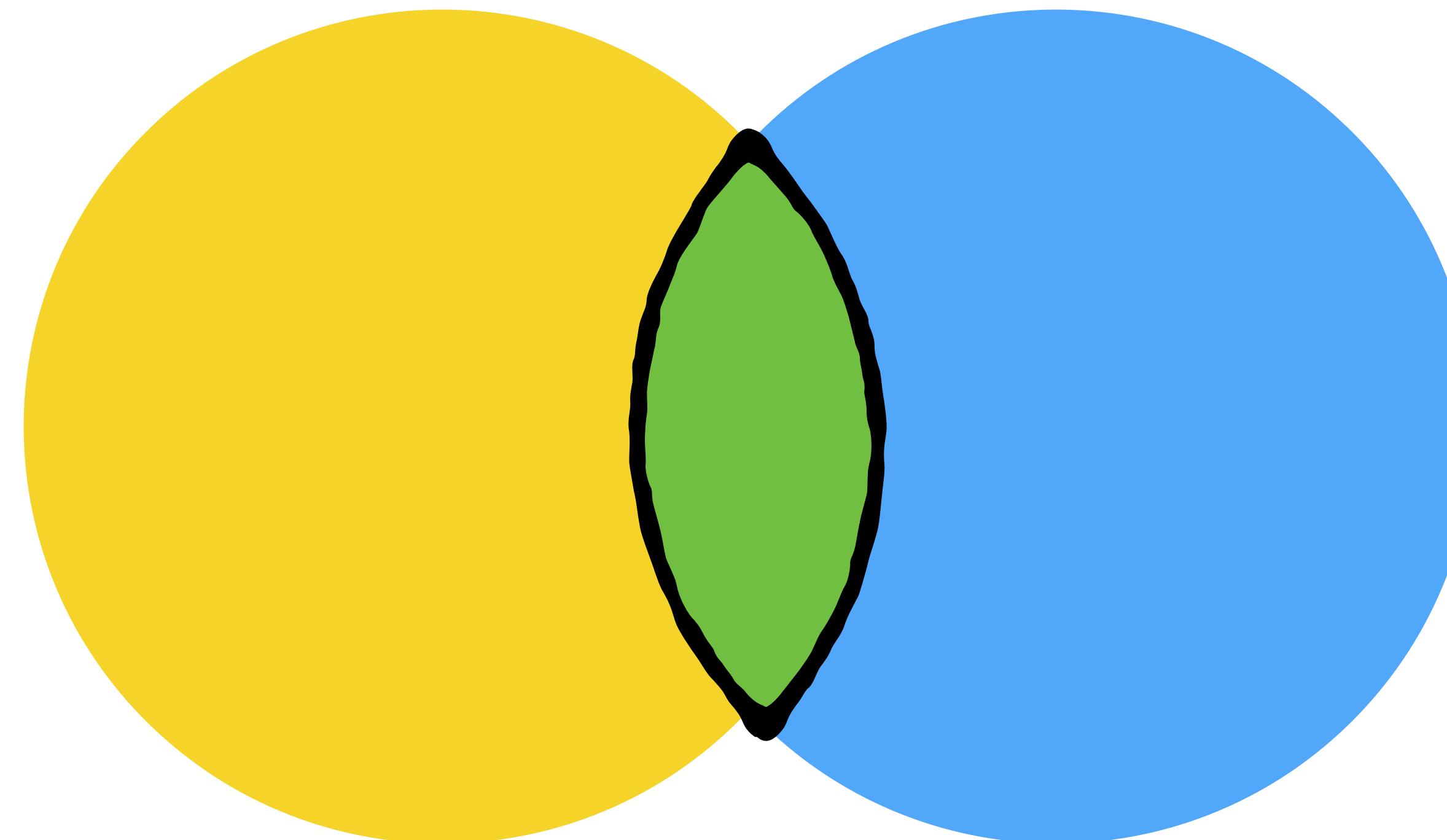
Cooperative vs Non-cooperative

Players can often find common ground



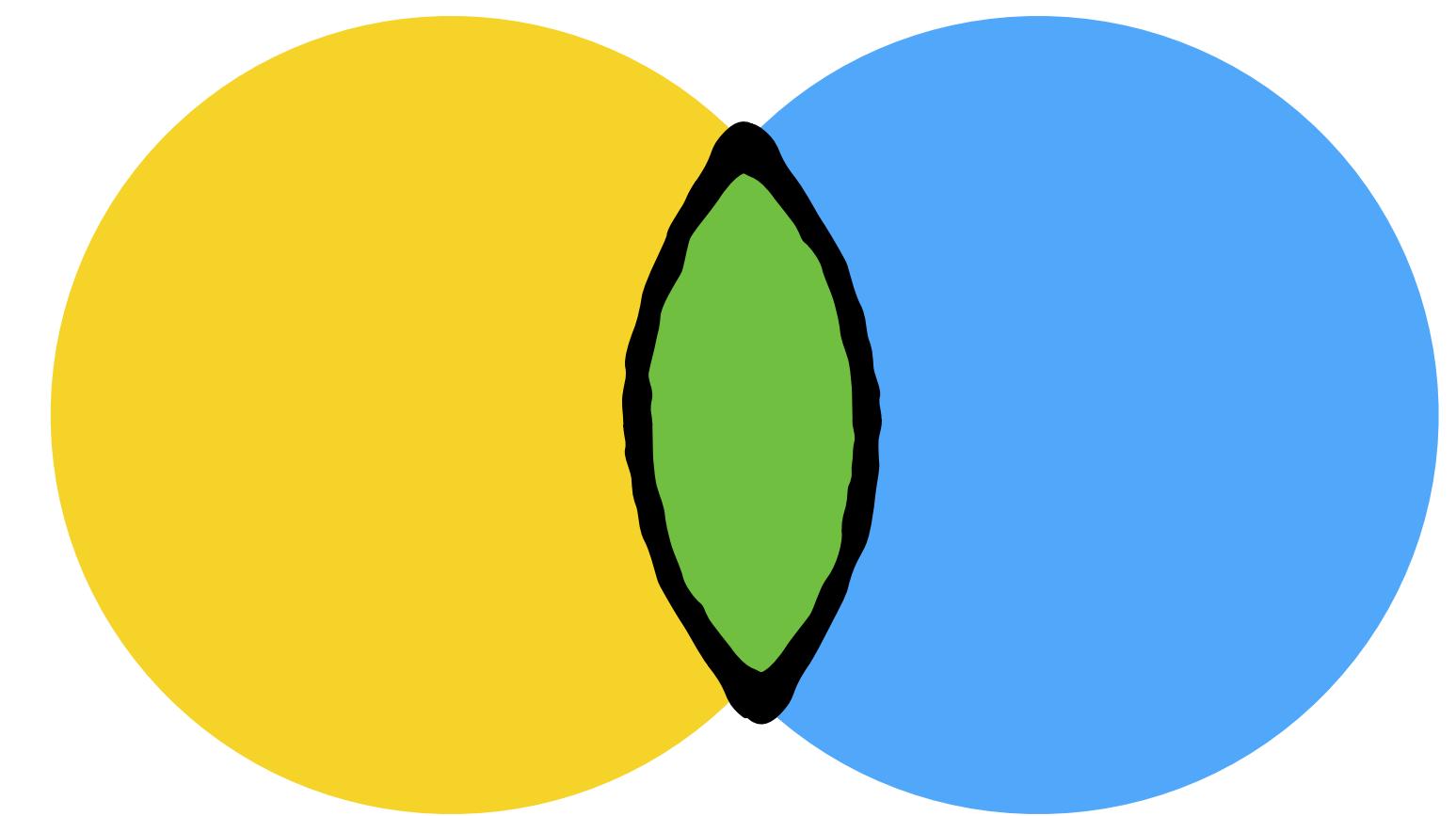
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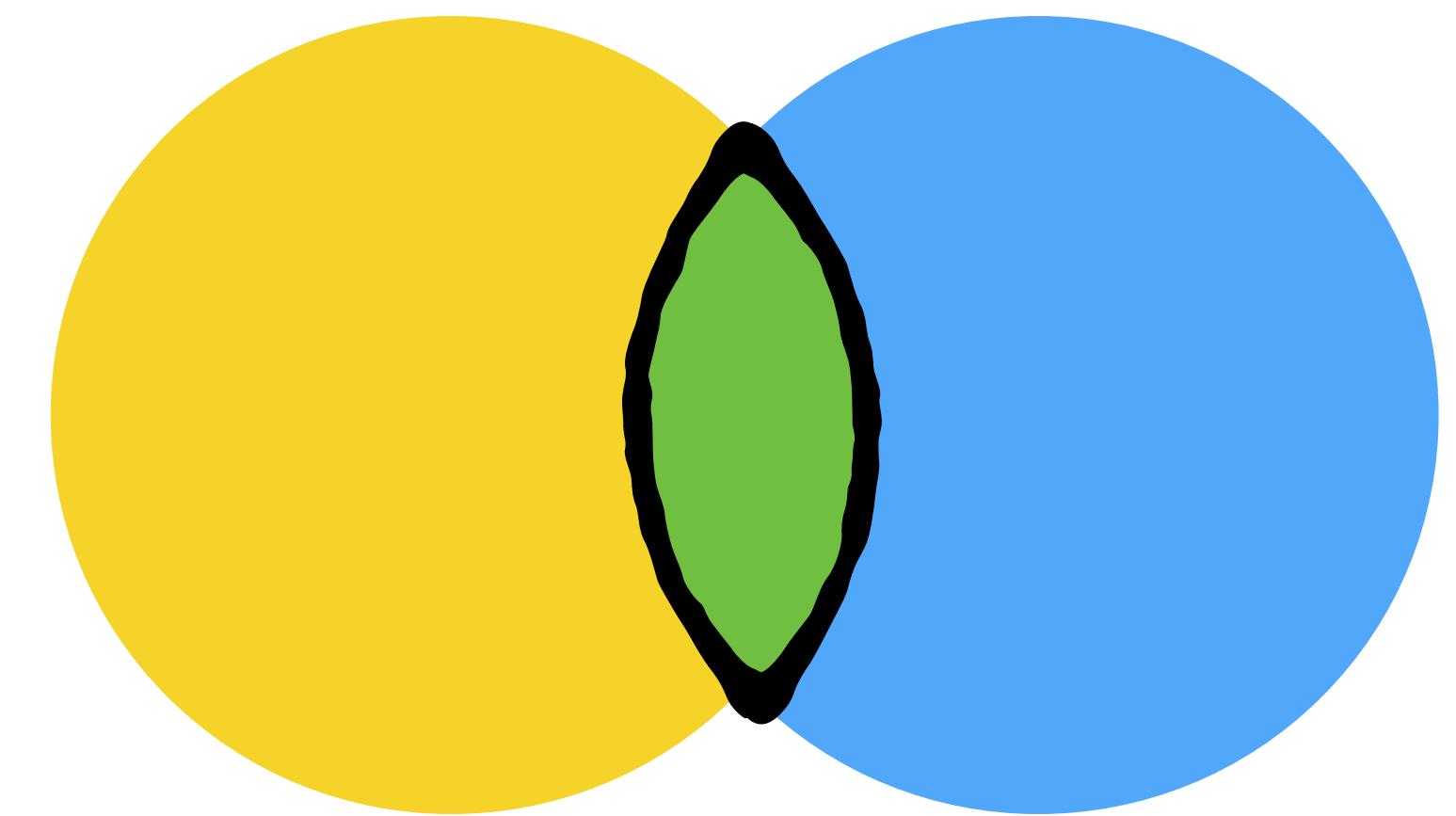
Cooperative vs Non-cooperative

In such cases, it makes sense for the parties to co-operate and reach an agreement



Cooperative vs Non-cooperative

But, that agreement
is meaningless unless
it is enforceable



Cooperative vs Non-cooperative

Let's say two countries negotiate a ceasefire



Cooperative vs Non-cooperative

There must be some significant downside to non-compliance

Otherwise, the ceasefire is not enforceable



Cooperative vs Non-cooperative

Games where there can
be enforceable
cooperative agreements

Cooperative games

Games where the
agreements are not
enforceable

Noncooperative
games

Cooperative vs Non-cooperative

In general,
enforceability is
ensured by an
external authority



Cooperative vs Non-cooperative

If the relationship
has to be continued

Fear of retaliation can
also help enforce
agreements

Tit-for-Tat



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One-shot game

Each set of players plays the game only once

Repeated game

The players play the game many times over a long period of time

One-shot game



A tourist

Repeated game



A local

A shopkeeper will play
differently with each of them

One-shot game



Try to squeeze as
much as you can
out of them

Repeated game



Promote loyalty
by giving them a
good deal

One-shot game



Incentive to hide
information,
mislead

Repeated game



Incentive to be
open and
trustworthy

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In a sport or a simple game

Chess, football, tennis

Rules are fixed

They are a given

In a sport or a simple game

Chess, football, tennis

Everybody, by definition,
plays by the rules



**Parent-child
interactions**



**Political back
room dealing**



Parent-child
interactions

Parents set the rules

Children try to circumvent
or bend the rules

**There are really no
set rules**

**Rules are fluid and
keep changing**



**Political back
room dealing**

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