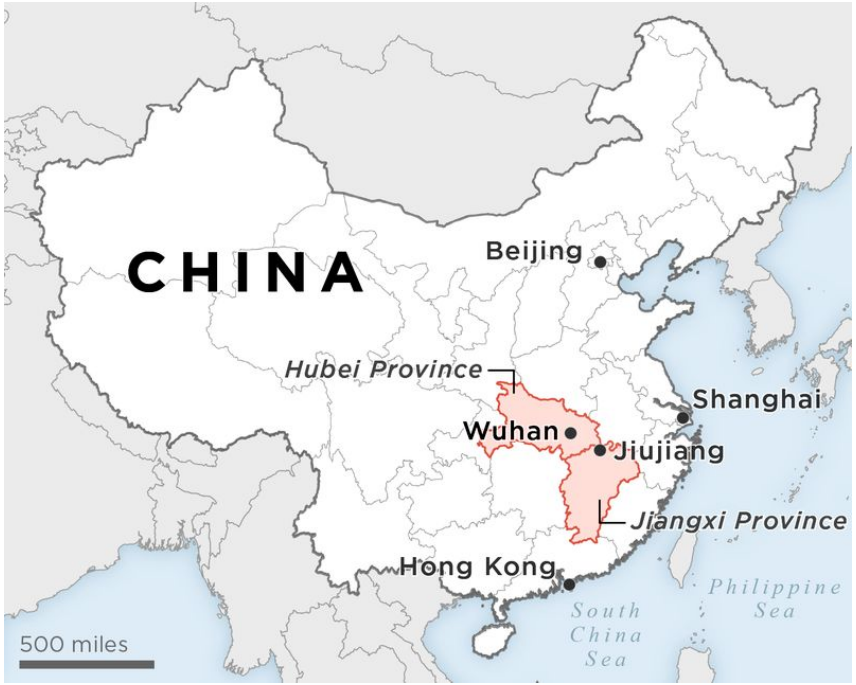
COVID-19

Eric Oliverio

COVID-19: Wuhan, Hubei



From NPR, Daniel Wood

On December 31st in the Hubei province of China, the city of **Wuhan** began treating dozens of citizens for sudden and serious cases of pneumonia.

Days later, a new virus would be identified as the cause of these cases.

On January 11th China would have its first virus-related death, after a 61-year old man who was a regular of Wuhan's markets passed away.

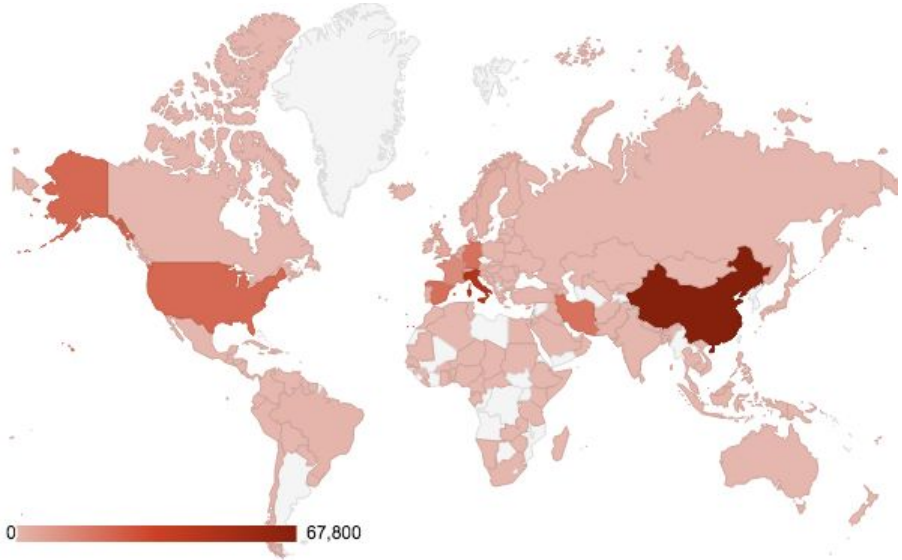
Spread in China/World

January would have the WHO declare a World Health Emergency. At this point there would be .. cases in china.

China would spend the new two months increasing testing and research, and locking off all travel from Hubei.

From NPR, Daniel Wood

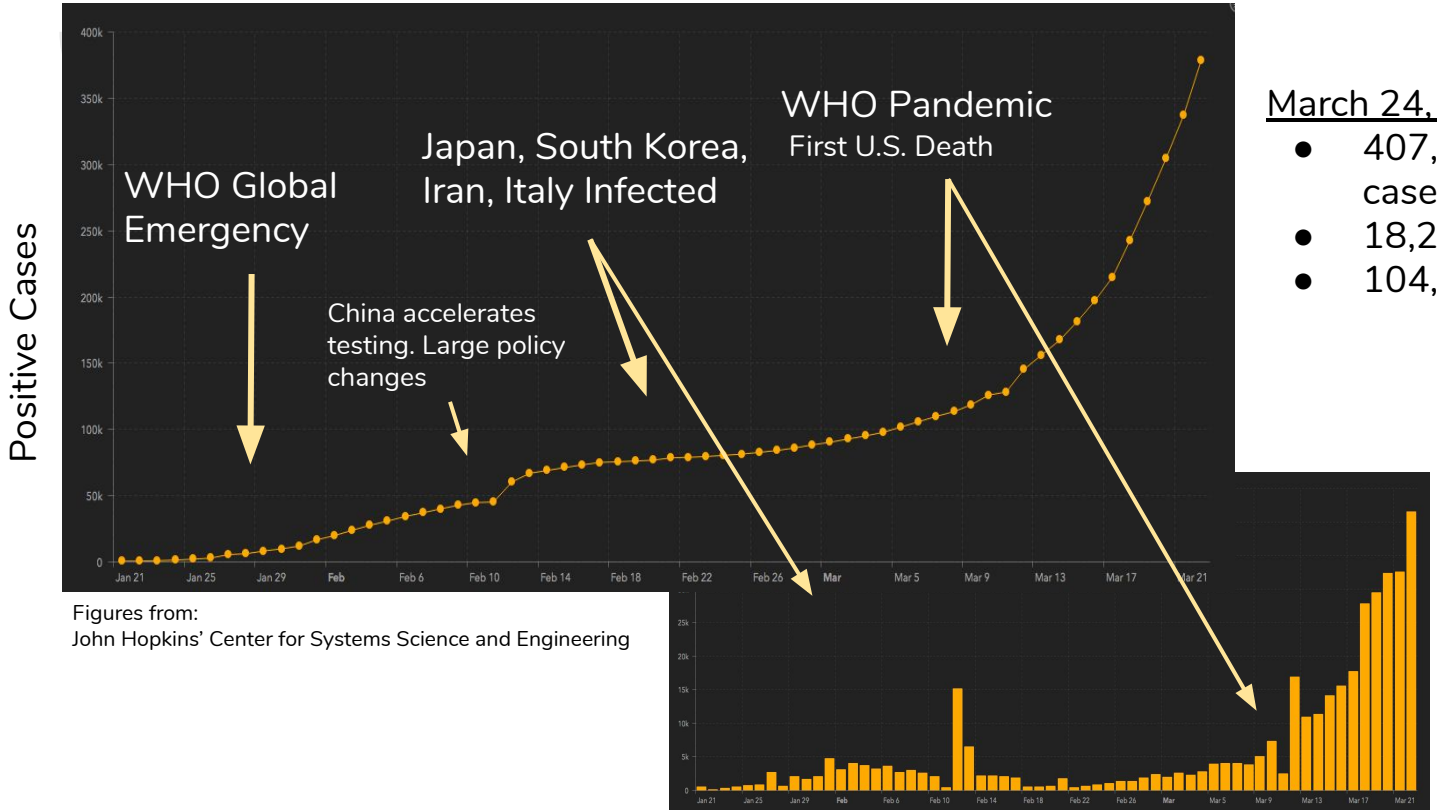
COVID-19: Current Global State



Cases per country. March 20, 2020.
Eric Oliverio. Data from...

By January 20th, cases of the virus would be reported in Japan, South Korea, Iran, Italy, Spain and the United States.

COVID-19: Current Global State



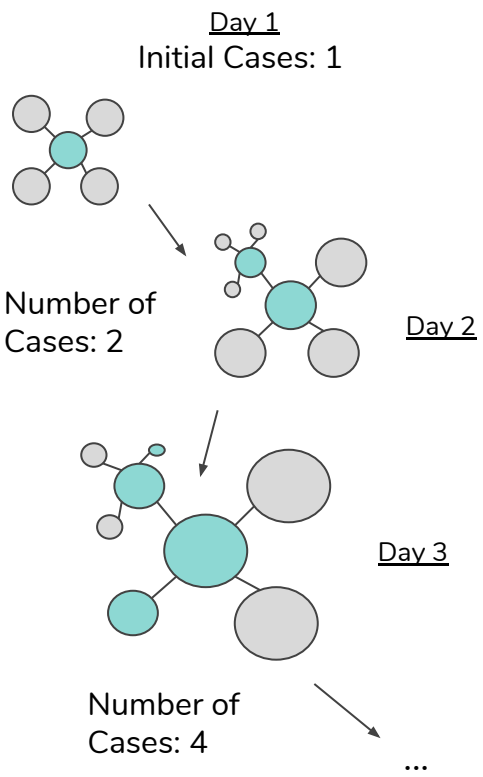
Figures from:
John Hopkins' Center for Systems Science and Engineering

March 24, 2020

- 407,485 confirmed cases
- 18,227 deaths
- 104,234 recovered

Modeling Epidemics

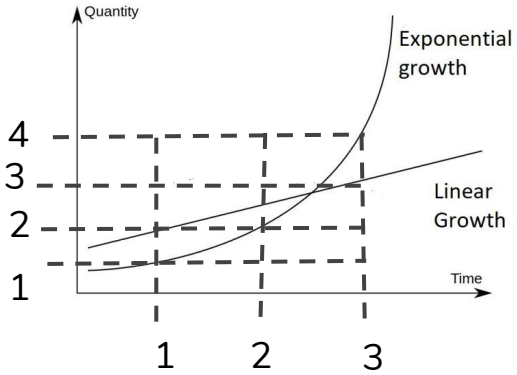
Disease Onset and Growth



Here, the number of cases double every day.

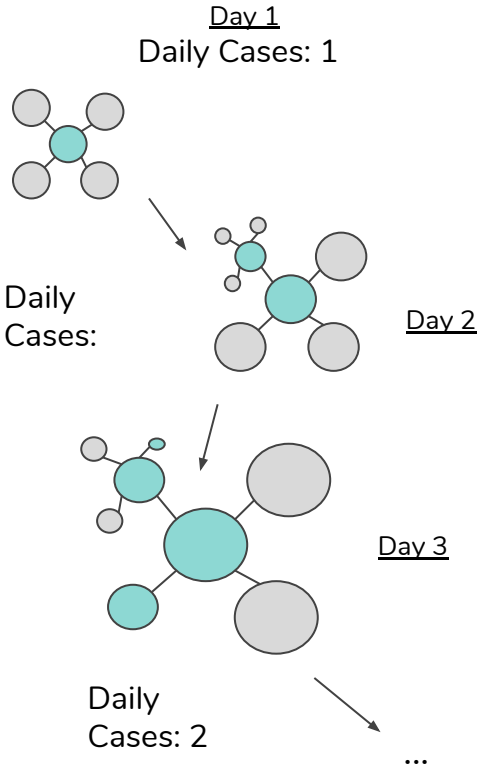
At this rate, after two weeks there will be more than 8,000 infected people.

Understanding the time it takes for cases to double is very important.

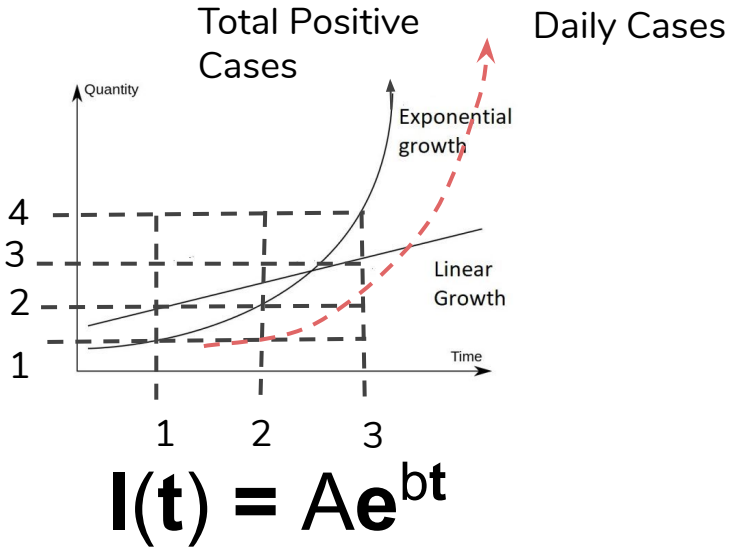


$$I(t) = Ae^{bt}$$

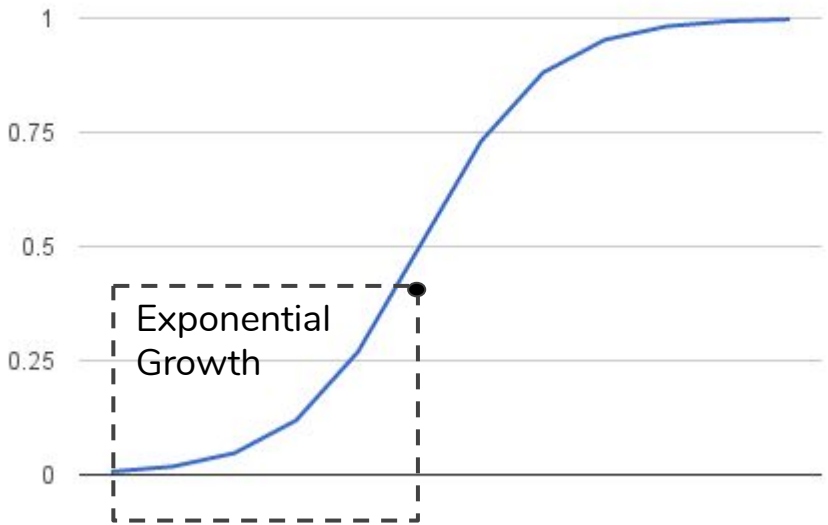
Disease Onset and Daily Cases



When thinking about to time to double, the number of **new daily cases**, can be equally informative.

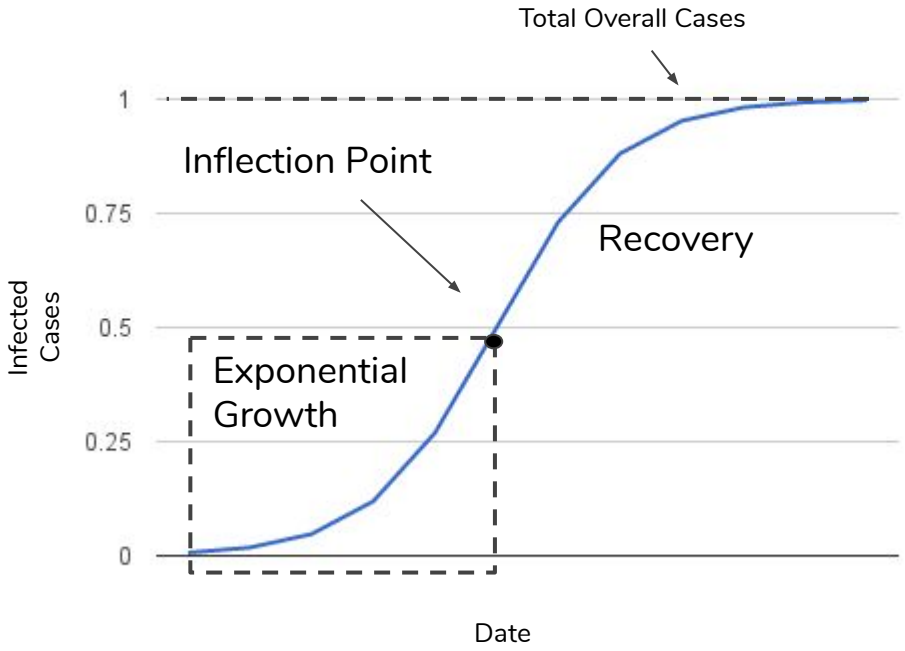


Slowing Growth: Logarithmic Functions



In nature, this growth is slowed either by population/environment capacities, the development of a medical treatment, or policy changes.

Slowing Growth: Logarithmic Functions

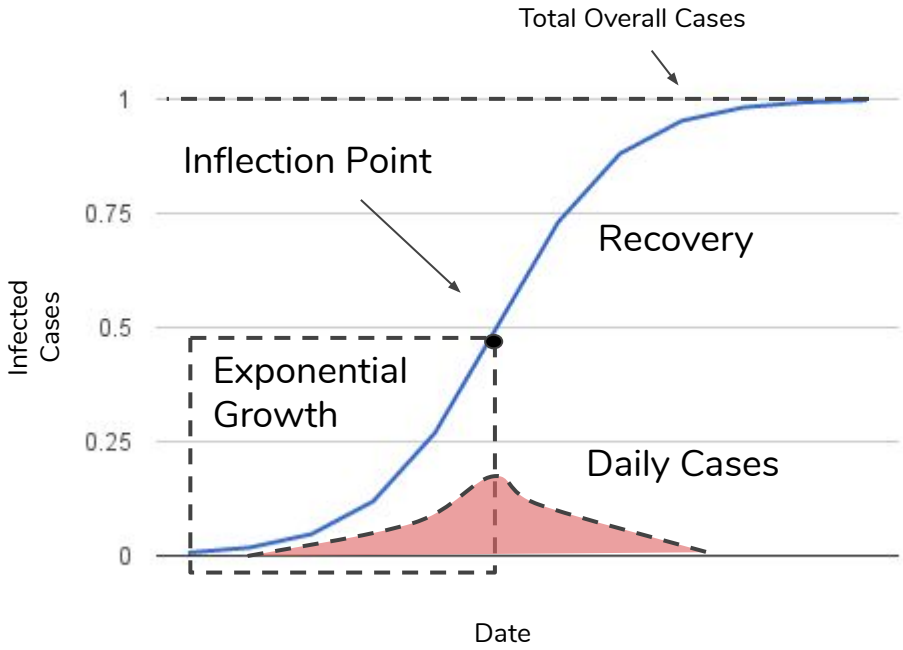


After an **inflection point**, the number of daily cases slows down. The virus still is spreading, but the worst is over.

The exponential growth slows and reaches a final maximum value, reflecting the total number of infected cases.

These two stages model the spread and recession of a disease.

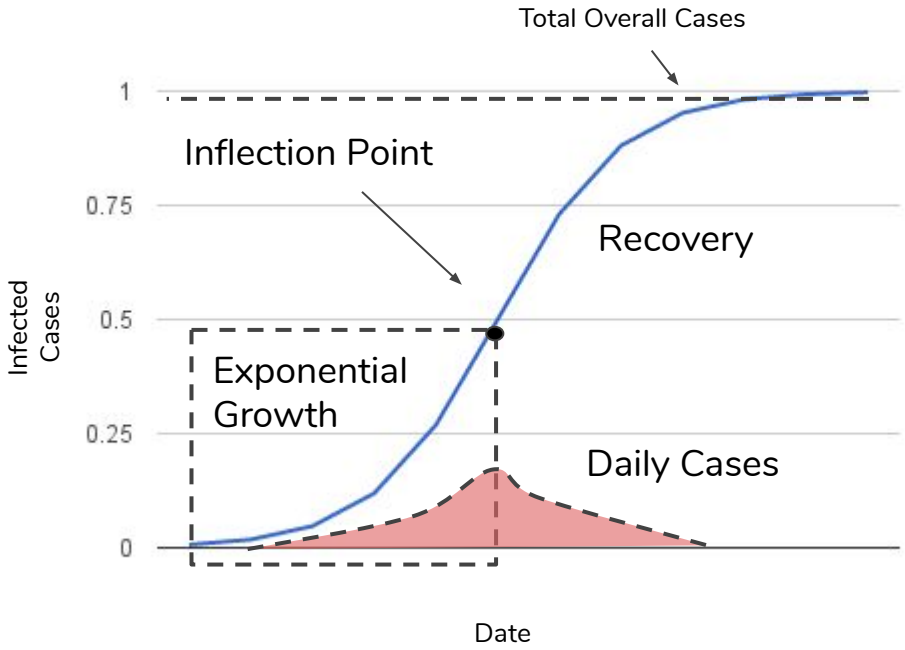
Slowing Growth: Daily Cases



When viewing the number of daily cases for a country, the inflection point marks to the with the **most daily cases** “the darkest day”.

After this point,the virus can be considered contained and the number of daily cases gradually decreases.

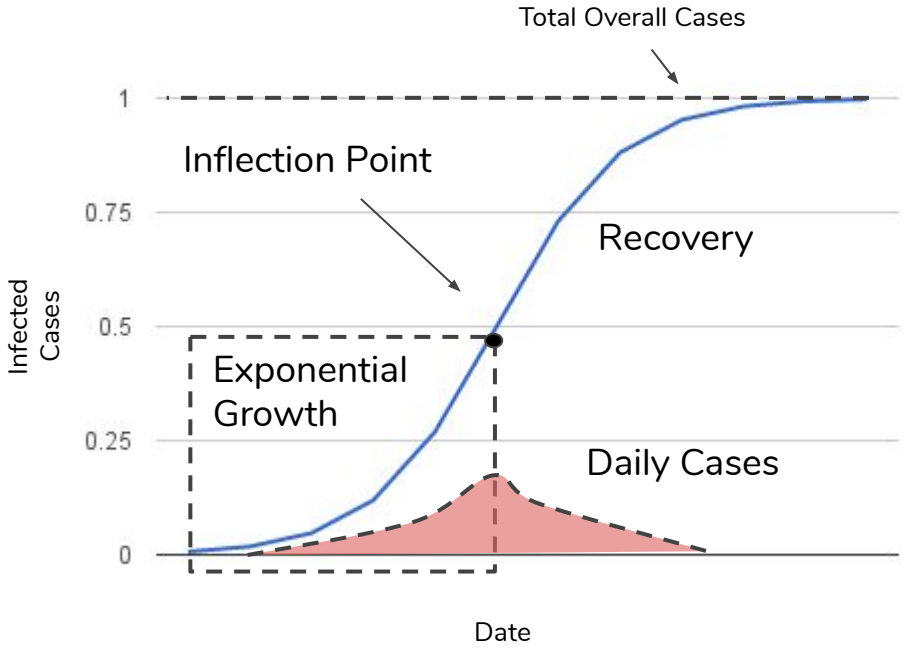
“Flattening the Curve”



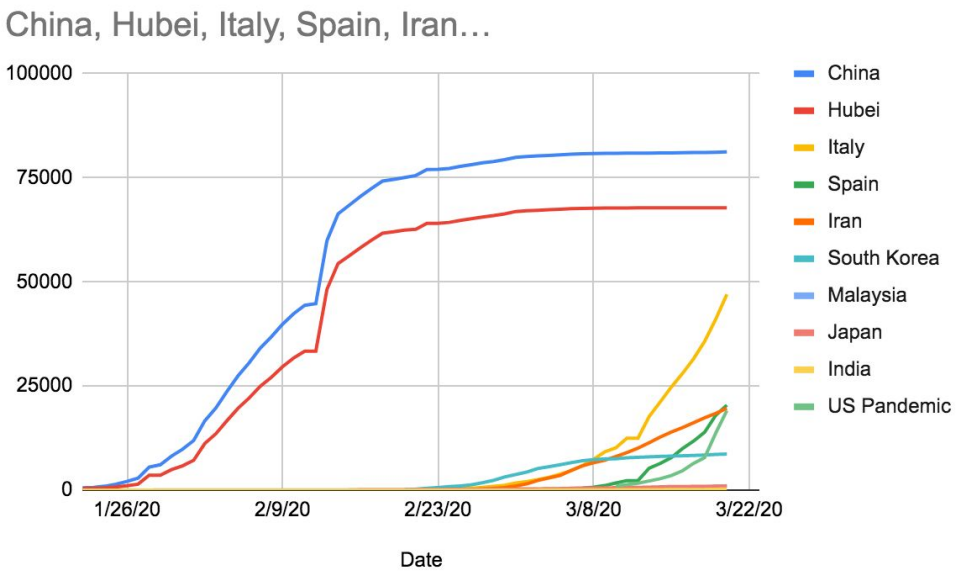
This inflection point, or “worst day”, is when most countries experience their most deaths, as the number of new cases surpass the medical capacity.

By making changes to reduce the exponential growth, the number of daily cases on the “worst” day can be reduced and prevent the medical system (ventilators) from being overwhelmed.

Slowing Growth: Growth Factor

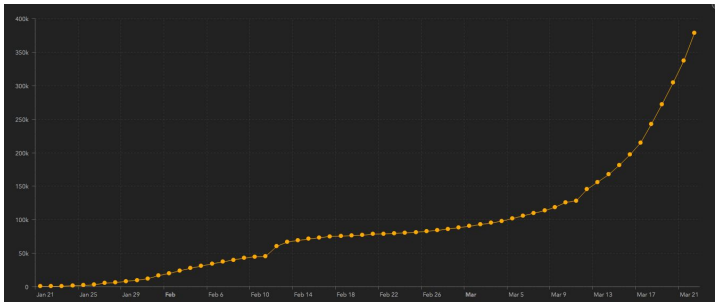


COVID-19 Data:

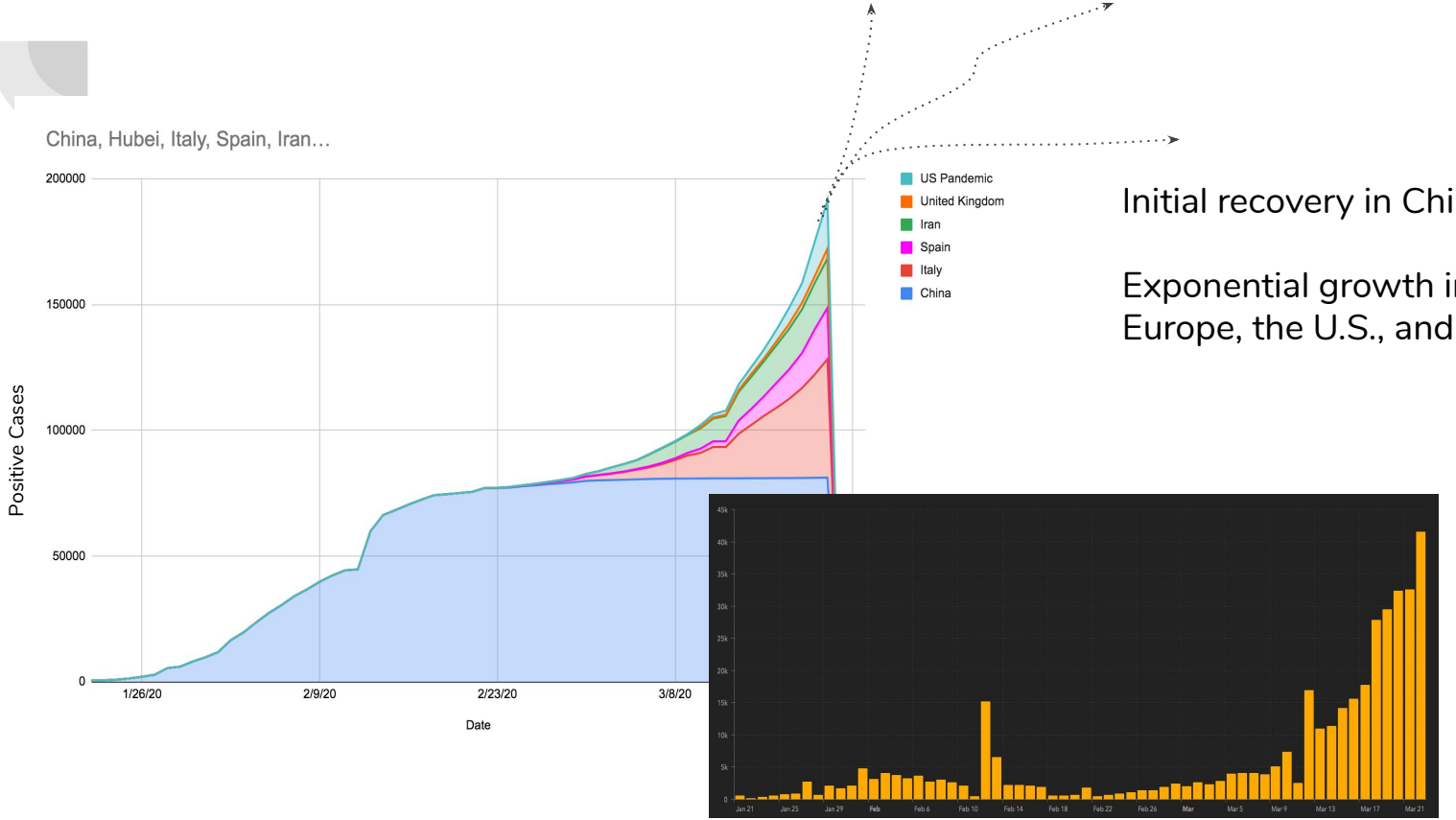


China, South Korea, and Japan in recovery - Logarithmic growth.

Iran, Italy, Spain, and the U.S. new hot spots of infection.



Global State of COVID-19: Total Cases



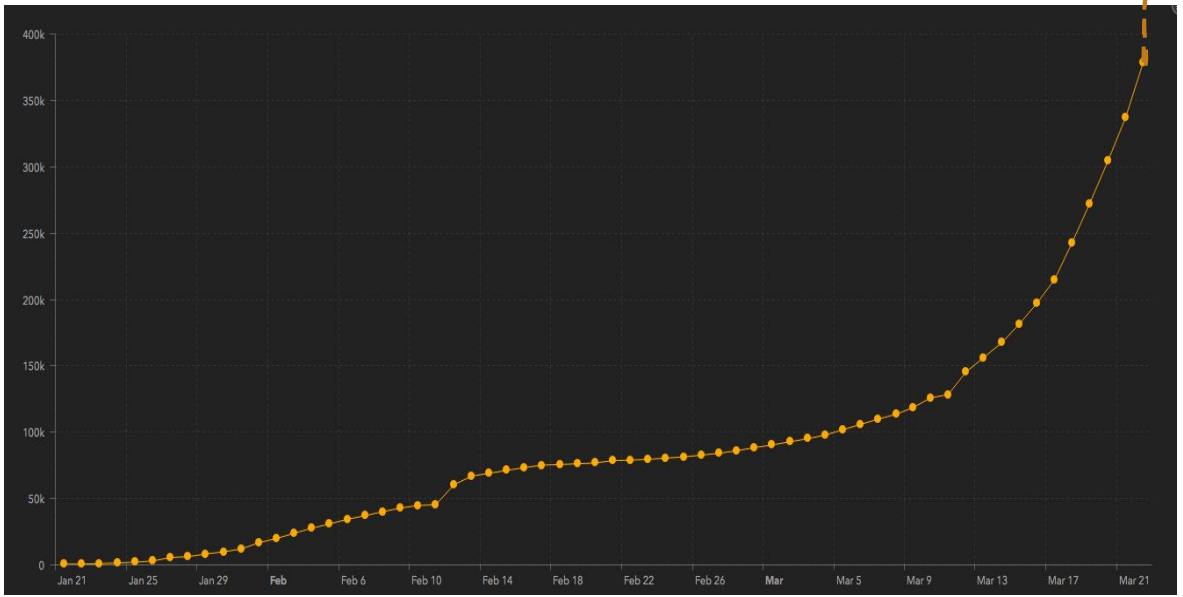
Initial recovery in China.

Exponential growth in Europe, the U.S., and Iran.

Daily Cases: Worldwide

Interpreting Global Data

COVID-19: Current Global State



John Hopkins' Center for Systems Science and Engineering

Exponential Growth:
Spread

Logarithmic Growth:
Recovery

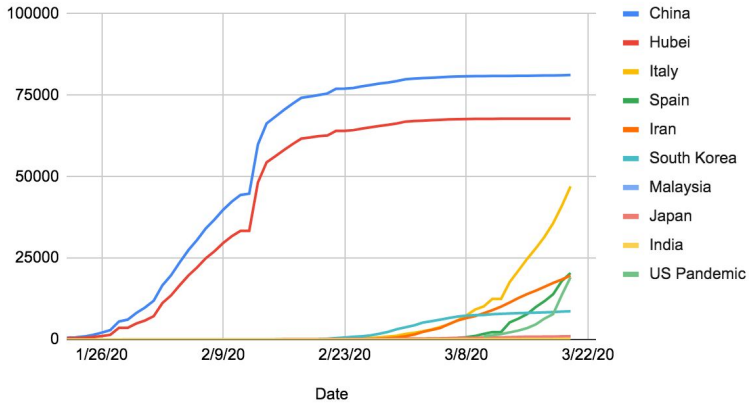
Where are we currently?

Period of exponential growth

How can we identify where this growth is coming from, and when the inflection point will occur?

Interpreting COVID-19 Data: Log Functions

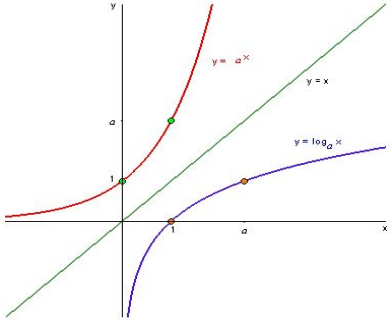
China, Hubei, Italy, Spain, Iran…



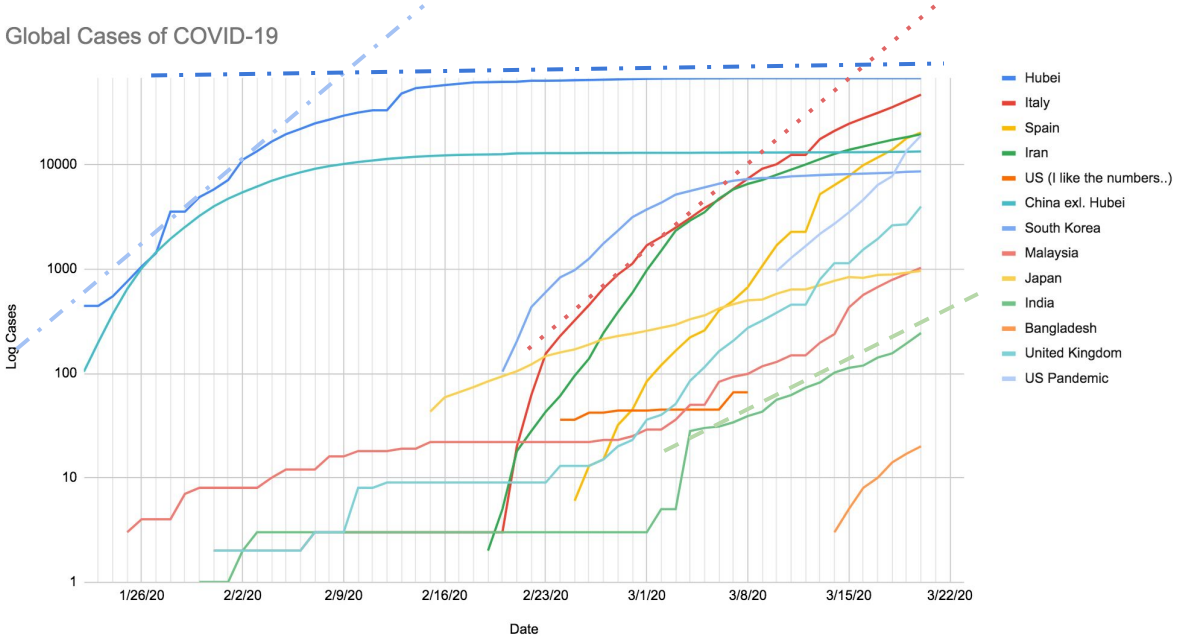
For functions that experience dramatic changes, plotting the **logarithm** of the function allows for subtle changes to be noticed.

If the growth of an infection is **exponential,** the logarithm of the growth is a straight line with a slope (r) determined by the rate at which the infection spreads.

$$\log(e^{rx}) = rx$$



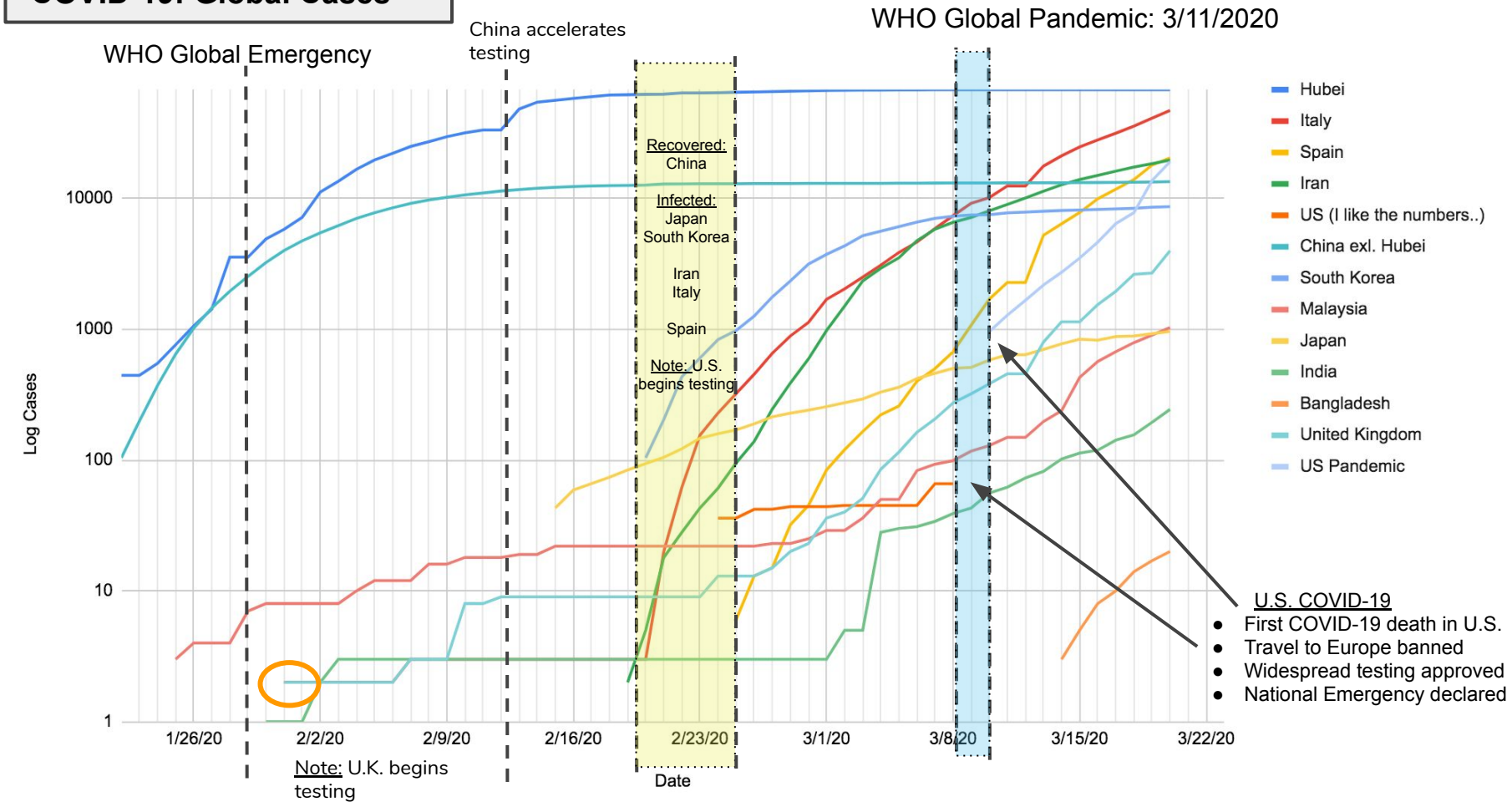
Interpreting COVID-19 Data: Log Functions



If the growth of an infection is ***exponential,*** *the logarithm of the growth is a straight line with a slope determined by the rate at which the infection spreads.*

- Changes in policy can affect the line's slope.
- The lower the slope, the slower the spread of disease.
- Flat = no spread.

COVID-19: Global Cases



Interpreting Local Data