

## WORKSHOP 1.12

Handout

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### Warm-up Problem

How many times do you need to fold this paper to reduce it to 25% ( $1/4$ ) of its initial size? How about 6.25% ( $1/16$ )? Can you come up with an equation that relates the number of times you fold the paper with the number of sub-squares produced by the fold?

### Worked Example

NASA has received intel on a zombie infection on earth. To avoid human extinction NASA designs a spacecraft to take a group of people to the international space station (where they will meet up with Sandra Bullock and George Clooney). The height of the spacecraft above earth, in kilometres, can be described using the function:  $H = 5^t$ , where  $t$  is in sec after launching. At the same time as the spacecraft is launched I start walking across the room. Where will the spacecraft be by the time I have reached the other end of the room ( $\sim 12\text{m}$ )? Assume an average walking speed of  $1.5\text{m/s}$ . How fast will the spacecraft be travelling at this time?

### Main Problem

Somehow, as usual, the evacuation was only available to the elite and you were left behind on earth with most of its population. This doesn't sound so bad at first because the zombie infection doesn't seem to be spreading as fast as you would have expected.

After a few months, scientists discover that the fraction of the abandoned population that has been infected can be determined in a precise way as a function of time. They release their findings to the public which state that the fraction  $f(t)$  of the remaining population that has been infected  $t$  years after the initial outburst is given by the following function:

$$f(t) = \frac{1}{1 + 9e^{-t}}$$

**Question:** According to the model, what fraction of the population was infected by the initial outburst?

**Question:** According to the model, after how many years will half of the population be infected?

**Question:** According to the model, what is the rate at which the fraction of the population consisting of zombies is increasing at this point in time?

**Question:** For a town of 50,000 individuals, when will the last human become a zombie, according to the model?