

# Data Science and Storytelling

IBM Services Academy



# Conrad Wolfram's 3 Steps for Mathematical Sciences

1. Start with a question that has real-world ramifications.
2. In the mathematical world, perform calculations or build models.
3. Return to the real world and verify that you've fully explored and answered the question.

**Fundamentally, all stories are arguments:  
they posit a question: can these two  
people fall in love, can the big bad be  
defeated, will the hero prevail, etc.**

# narrative

A recounting of selected events, arranged so as to create causal connections, and leading to a specific outcome.

TIME	TITLE	PLOT	PROPHETIC HALL OF PROPHECY	Cho/Ginny
OCT	<del>Plots and Resistance</del>	Snape lesson - Harry skips lesson Harry, Ron + Hermione go to Hogsmeade, meet Lupin and Tonks - cart talk, Umbridge talking - pass note. They recruiting for O.P.P. Magnifico fresh my wands	Harry sees <del>Vol</del> & Vol still formulating his plans. Before O.P.P. Des decide to get in + Vol's plan to attack Cho + Ginny	Cho in Hogsmeade - wants to join O.P.P.
NOV	The Order of the Phoenix	first meeting of the Order of the Phoenix	Cho + Ginny both present	Cho + Ginny
NOV	<del>The Dirtiest Tackle</del>	Quidditch versus Hufflepuff - Harry suspended following attack on an unsuspecting Cedric Diggory - that night, Cedric dies - Harry follows up with loss, unable to sleep following match - Umbridge etc - Cho sleeps well - Cedric's death - Nagini attacks Mr. Weasley	Nagini cuts in, Vol has confirmation of Bode's story - only he + Harry can touch the prophecy	Cho now really in love
NOV	<del>Black Marks</del>	Rowle skipping Snape lesson - Harry healthy in day however he copy's Umbridge's Xmas. Hermione contacts Rita - Harry misses match - Umbridge replaces him - Rita information - Misery slipkiss	Harry now avoids Cho a bit - Ginny + S.O. else?	Cho kiss? Ginny about father
DEC	Rita Returns	Snape lesson / Xmas shopping, Hogsmeade / they meet Rita	Now VOL IS ACTIVELY TRYING TO GET HARRY TO H.G.P - very vivid - could see some	Ginny + Dad
DEC	St. Mungo's Hospital for Magical Maladies and Injuries	St. Mungo's visit Xmas Eve - see Bode (Macnair visiting) - see Lockhart - see Mr. Beasley Neville	Bode dead - go H.G.P again	Hermione + Ginny + Ron girls next
DEC	(Xmas)	Harry misses match v. Hufflepuff Order of Phoenix now suspected by Umbridge - who were in match? with Cho. Hogsmeade - The Leaky Cauldron - Fleur replaces him - Rita reports back on Grawe - Rita reports back on Bode etc. Snape lesson?	Harry fightin sport not face exp. but visitors very nicely	Valentine date with Cho - v. miserable - they could row.
JAN	Extended Powers of Elvira Umbridge	Umbridge now really gone for Harry - finance teaching somehow prophetic + prophecies - H.G.P go to war Nagini + Umbridge meet Grindelwald	↓	
FEB	(Valentines day)			
FEB	Cousin Grange	Easter - discovery of O.P.P - Dumbledore takes the ring XX - Azkaban	Harry starting to get it - blacked out	Cho wants back with Harry another row
MARCH	(Treason)	Careers consultation - Auror Order of Phoenix continues - Ginny has decided on the wall in temper. Snape lesson	Harry starting to get it	
APRIL	<del>Careers Guidance</del>			

# premise

**The singular conceptual or thematic foundation of the story, against which events are measured for inclusion or exclusion.**



To craft a narrative is to not only present a position but to lead the audience through thesis (successes) and antithesis (failures) to reach a persuasive synthesis that answers the story's question.



The Atlantic

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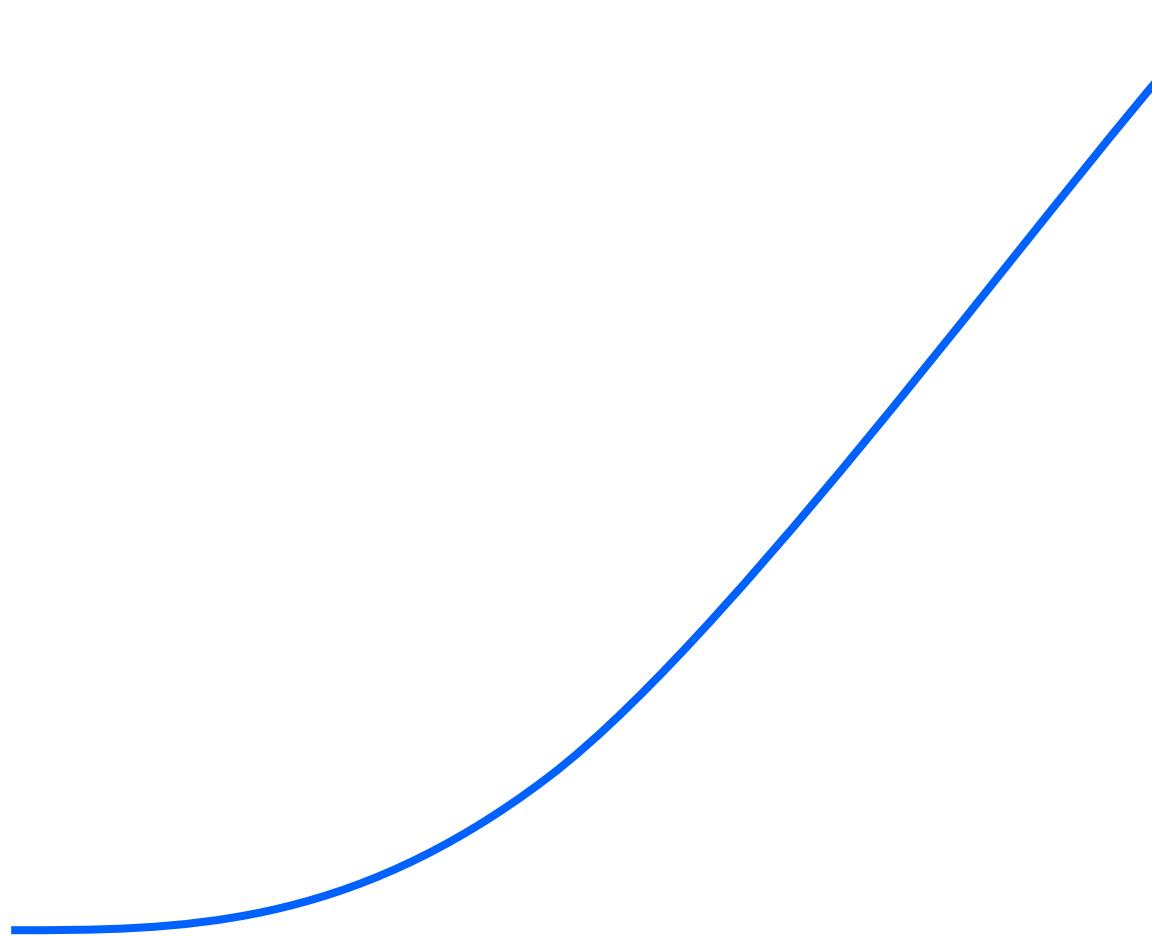
# The Six Main Arcs in Storytelling, as Identified by an A.I.



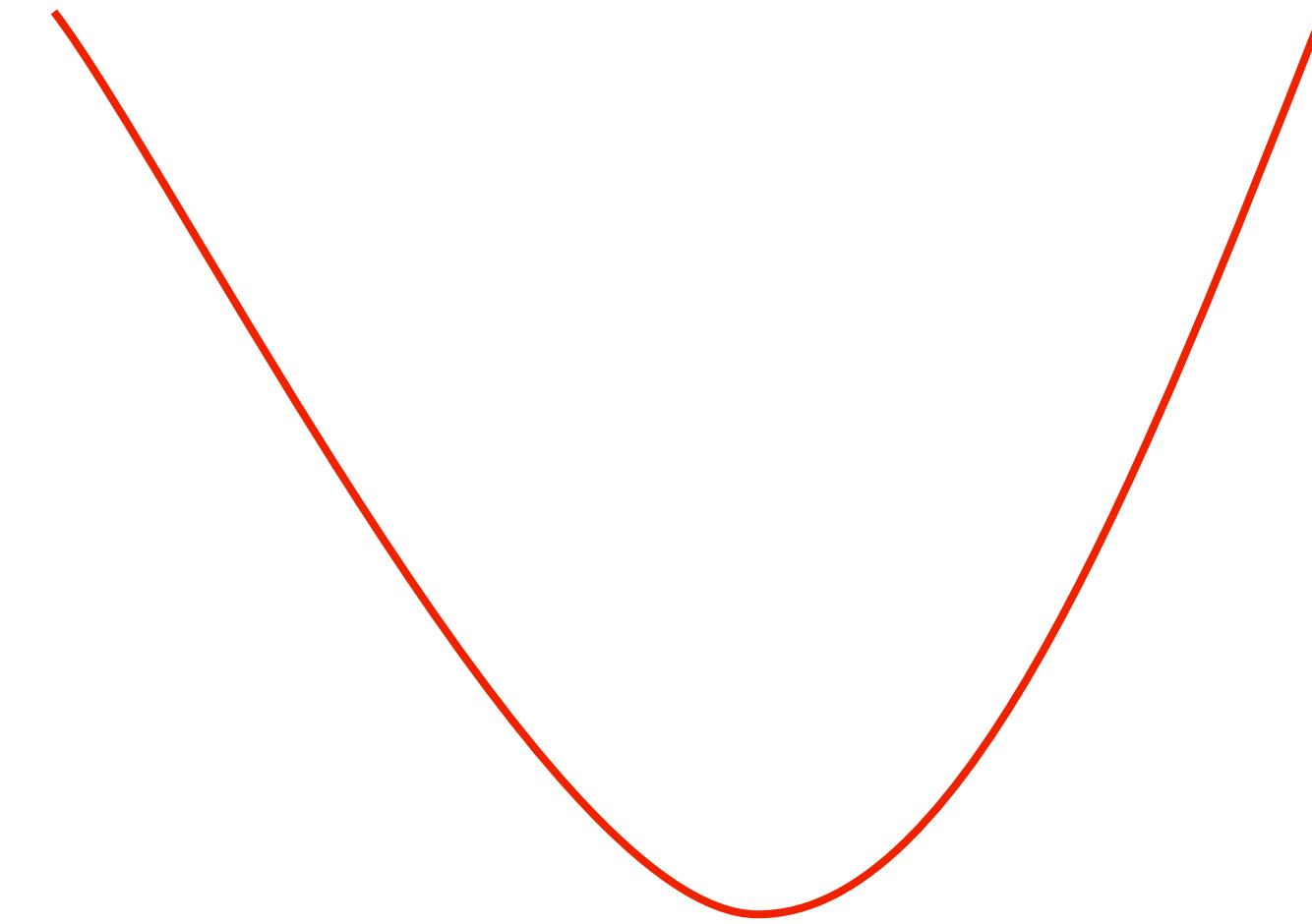
*Photo by: Khaled Abdullah / Reuters*

“My prettiest contribution to my culture,” the writer Kurt Vonnegut mused in his 1981 autobiography *Palm Sunday*, “was a master’s thesis in anthropology which was rejected by the University of Chicago a long time ago.”

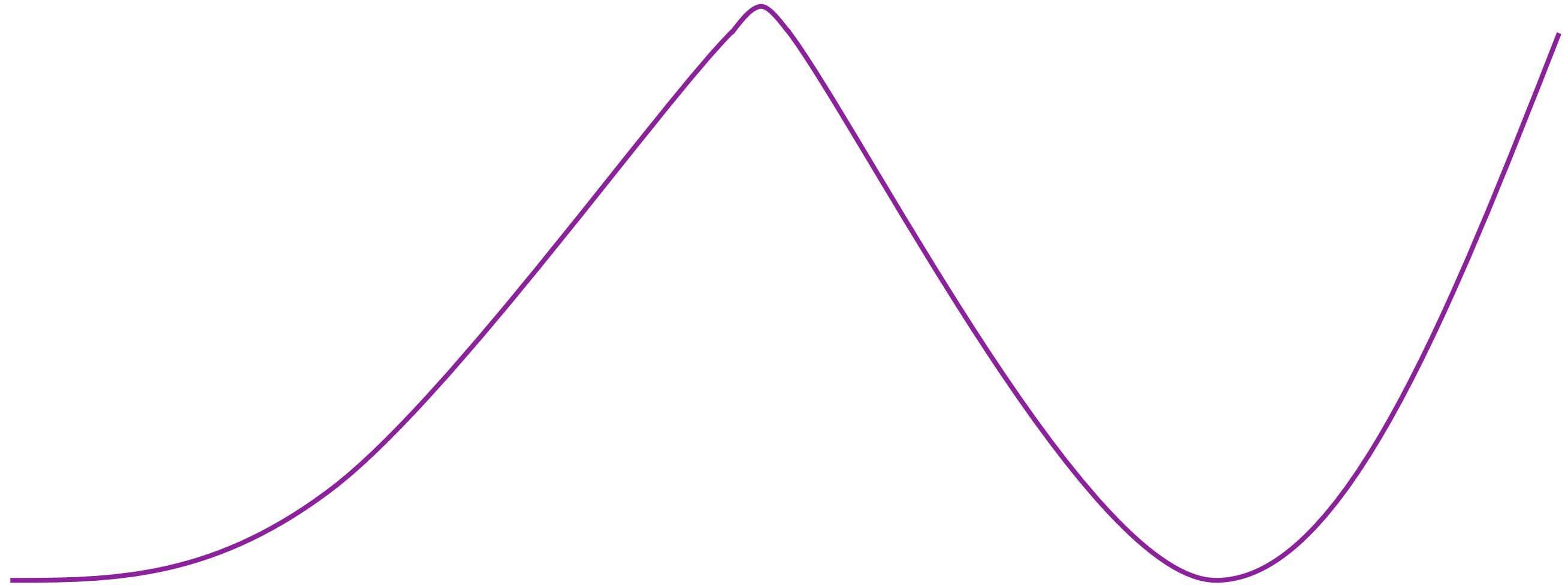
# Most common story-shape to write: Rags to Riches



# Common favorite story-shape to read: Man in a Hole



# Top favorite story-shape to read: Cinderella



# **what the character wants**

A desire stemming from, and satisfying to,  
the lie the character believes.



# the inciting incident

The true start of the story, where the character can no longer stay (or return) to their previous known situation.



# **the character's lie**

**A self-protective coping mechanism the character developed, which allowed the character to successfully manage a difficult, stressful, or traumatic situation.**



# the try/fail cycle

Each time the character stays with old coping mechanisms (the lie they believe) and reaches for their desire (the want), the world/story punishes them with failure.



# the midpoint

The tension climaxes when the character realizes it's time to outgrow their old coping mechanisms (the lie).

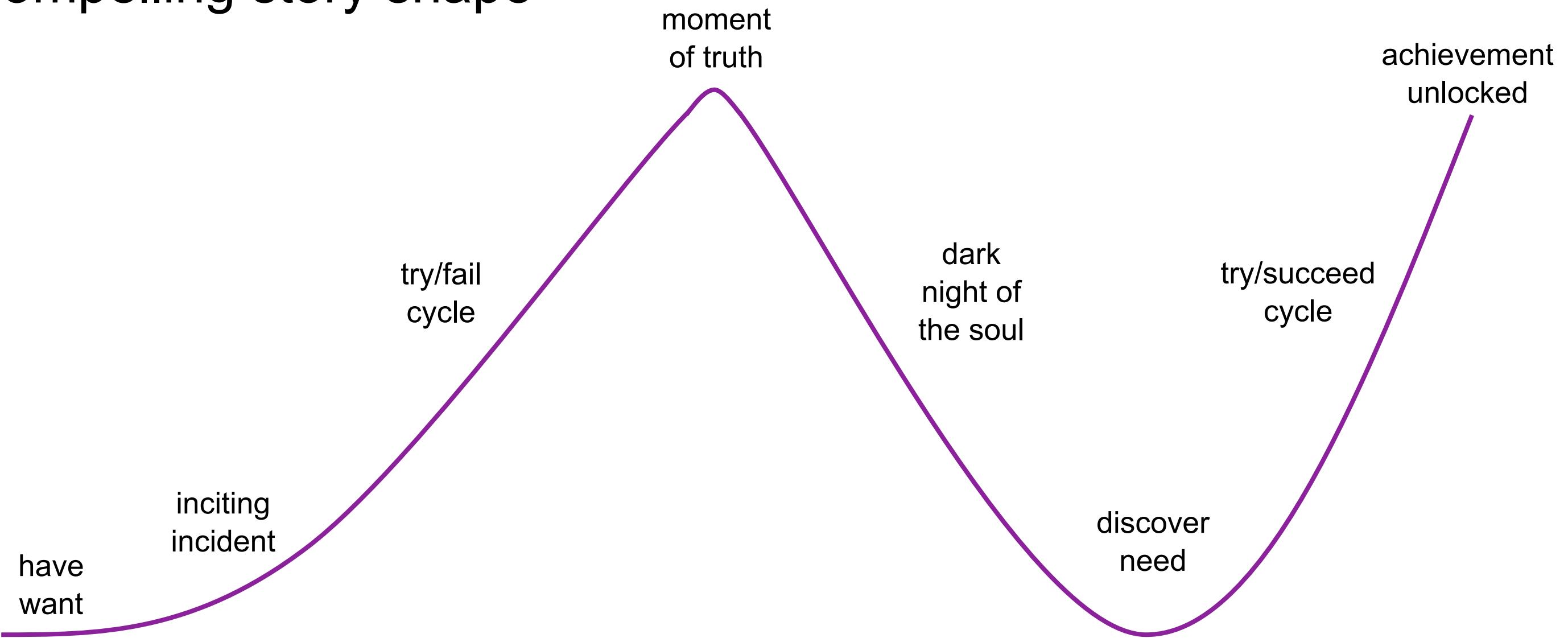


# what the character needs

The character's true goal is revealed once the character accepts the truth of themselves and their (new) world.



# Compelling story shape



# Let's translate this into a real story.

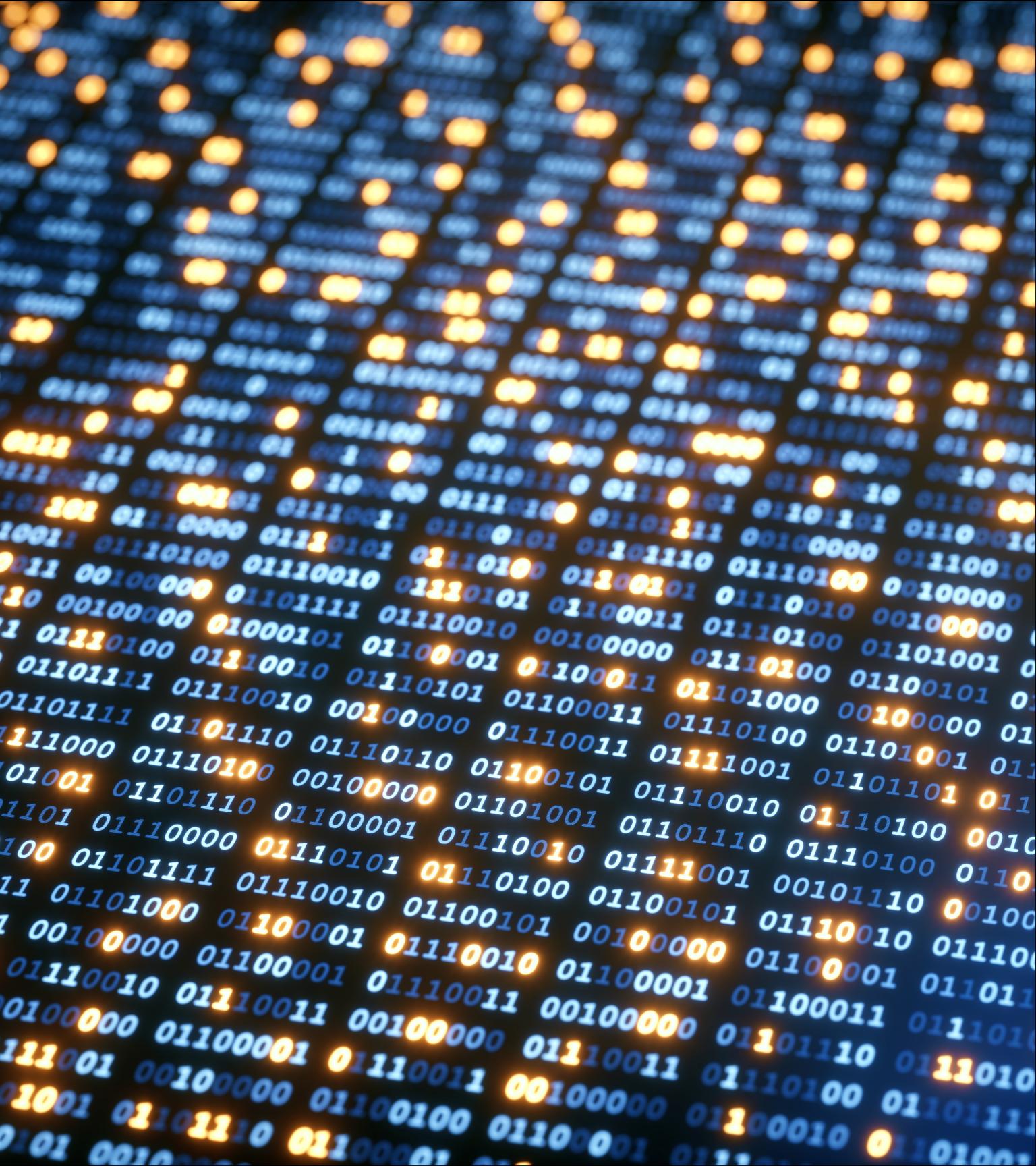
# what the character wants

Reduce costs by half while simultaneously  
doubling profits.



# inciting incident

An Oxford study estimates that automation could make up to 47% of US jobs obsolete in the next 20 years.



# the try/fail cycle

Multiple models, attempts, iterations, and strategies to achieve the theoretical 47%.  
None of them seem to work.

2 $\pi\sqrt{\frac{L}{g}}$  simple pendulum  
 $2\pi\sqrt{\frac{E}{mgh}}$  physical pendulum  
 $y(x,t) = y_m \sin(kx - \omega t)$  wave in pos direction  
 $v(t) = -\omega x_m \sin(\omega t + \phi)$   
 $a(t) = -\omega^2 x_m \cos(\omega t + \phi)$

$k = \frac{2\pi}{\lambda}$   $\nu = \frac{\omega}{K} = \frac{\lambda}{T} = \lambda f$   $v = \sqrt{\nu}$   $\nu = \frac{m \omega s}{length}$   $P_{ave} = \frac{1}{2} \nu v w^2 y_m$

since  $\lambda = \frac{2L}{n}$   $n=1,2,3$   $V = \sqrt{\frac{\rho}{P}} \cdot \text{bulk modulus}$   $\Delta P_m = \nu \rho w S_m \cdot \text{displacement}$   $f = \frac{\nu}{\lambda} = \frac{1}{2L} \nu \approx \frac{1}{2L} \nu$  pipe 2 open ends  
 $\frac{V}{\lambda} = \frac{1}{2L} n = 1,2,3$   $P_m^2 = 2PVl$  pressure  $f_{bed} = |f_1 - f_3|$  pressure node  
 $\text{reference}$   $P_m = \nu \rho w S_m$   $I = \frac{\text{Power}}{\text{Area}} = \frac{P_s}{4\pi r^2}$  pipe 1 open end  
 $\nu = 0.5, 1.5, 2.5$  fully constructive  $\theta = \frac{\Delta L}{\lambda} 2\pi$   $I = \frac{1}{2} \rho v w^2 S_m^2$   $\sin \theta = \frac{V}{V_s}$   $\frac{V_s}{V} = \text{mach #}$   $\Rightarrow I = 1 \times 10^{-12}$   
 $\nu = 0.5, 1.5, 2.5$  fully destructive  $B = 3\alpha$   $\theta = C \Delta T$   $f = f \frac{V - V_d}{V \pm V_s}$   $B = (10) \log \frac{I}{I_0}$   
 $\Delta L = L \alpha \Delta T$   $Q = C_m AT$   $Q = L m$   $W = \int_V^\infty \frac{V}{P} dV$   $\log \frac{x}{y} = \log x - \log y$   
 $= \frac{9}{5} T_c + 32$   $\Delta V = V \beta \Delta T$   $\text{specific heat}$   $\text{Heat of transformation}$   
 $E_{int} = Q - W_{out}$   $P_{cond} = \frac{Q}{t} = k \alpha \frac{T_b - T_c}{L}$   $R = \frac{L}{k}$   $P_{radiation} = \sigma \epsilon A T^4$   $P_{net} = P_{abs} - P_{rad}$   
 $\text{molecules}$   $P_{cond} = \frac{A(T_b - T_c)}{\sum \frac{1}{k}}$   $R = \frac{L}{k}$   $\epsilon = \frac{5 \times 10^{-8} W}{m^2 K^4}$   $P_{abs} = \sigma \epsilon A T_{env}^4$   
 $6.02 \times 10^{23}$   
 $bolt$   $Q = 0$   $\Delta E = -W$   $PV = nRT$   $R = 8.31 \frac{J}{mol \cdot K}$   $V_{rms} = \sqrt{\frac{3RT}{M}}$   
 $vol$   $W = 0$   $\Delta E = Q$   
 $cycle$   $\Delta E = 0$   $Q = W$   $W = nRT \ln \frac{V_f}{V_i}$  (isothermal)  $k_{Boltz} = \frac{3}{2} kT$   $M = \text{molar mass}$   
 $exp$   $Q = W = 0$   $\Delta E = 0$   $\Delta T = 0$   $T_f:V_f = T_i:V_i^{\gamma-1}$   $P_f:V_i^{\gamma} = P_i:V_f^{\gamma}$  (adiabatic)  
 $= \frac{3}{2} nRT$   $Q = nC_V \Delta T$  (constant Volume)  $\gamma = \frac{C_P}{C_V}$   $V_{avg} = \sqrt{\frac{8RT}{\pi M}}$   
 $\text{changes}$   $W = P\Delta V = nR\Delta T$  (constant pressure)  
 $\frac{3}{2} R$   $C_V = C_P - R$   $\Delta E = \frac{3}{2} nR\Delta T$   $T_f:V_i^{\gamma-1} = T_i:V_f^{\gamma-1}$   $P_f:V_i^{\gamma} = P_i:V_f^{\gamma}$  (adiabatic)  
 $\text{changes}$   $\Delta S = \int \frac{dQ}{T}$   
 $= nC_V \Delta T$   $\Delta S = \left( \frac{Q_f}{T_f} - \frac{Q_L}{T_L} \right)$   $\text{Translational}$   $3$   $3$   $\frac{3}{2} R$   $\frac{5}{2} R$   $\Delta S = \frac{R}{T}$  isothermal/  
 $\text{exp } P_f:V_i^{\gamma} = P_i:V_f^{\gamma}$   $\text{Rotational}$   $3$   $0$   $3$   $\frac{5}{2} R$   $\frac{7}{2} R$   
 $\text{Polyatomic}$   $3$   $3$   $1$   $3R$   $4R$   $\Delta S = \frac{Q}{T_{ave}}$   $S_{0,II} \Delta T$   
 $|Q_f| - |Q_L|$   $\frac{|Q_f|}{T_f} - \frac{|Q_L|}{T_L}$   $\epsilon = \frac{|w|}{|Q_f|} \text{ energy we get}$   $\Delta S = nR \ln \left( \frac{V_f}{V_i} \right) + nC_V \ln \frac{T_f}{T_i}$   
 $\text{generator}$   $K = |Q_L|$  what we want  $\epsilon_c = \frac{|Q_f| - |Q_L|}{|Q_f|} = 1 - \frac{|Q_L|}{|Q_f|}$   $\epsilon_c = \frac{|Q_f| - |Q_L|}{|Q_f|} = 1 - \frac{|Q_L|}{|Q_f|}$

# the midpoint

Aiming for an easy fix worked when technology was young, but now it's time to recognize the goal is based on a faulty premise. In fact, very few occupations—less than 5%—could be fully automated.

“Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation”, McKinsey Global Institute



# Conrad Wolfram's 3 Steps for Mathematical Sciences

1.

Start with a question  
that has real-world  
ramifications.

**premise**

2.

In the mathematical  
world, perform  
calculations or build  
models.

**try/fail cycle**

3.

Return to the real  
world and verify that  
you've fully explored  
and answered the  
question.

**climax**

## A few things to remember

### Be careful with comedy.

Little is more personal and unpredictable than our senses of humor, and little can backfire worse than misapplied comedy.

### Remember the real hero of the story.

It's not you. It's your audience.

The stories we find most compelling are the ones where we are (or can relate to being) the protagonist.

### Know what's at stake.

What catastrophe or failure will happen, if you can't answer the question? What do you stand to lose?

The story shape of a narrative without any risk is a flat line.

## Useful hacks and tips

### Learn your audience.

Apply social engineering to identify themes your audience might find personally compelling.

### Raise a question and answer it.

If the opening question (the premise) changes during discovery (the try/fail cycle), make explicit the new question that developed (midpoint).

### Apply a formula.

*Fiction: X is the protagonist, Y is the antagonist. They meet at Z and all L breaks loose. If they don't solve Q, then R starts, and if R starts, it's L squared.*

*Non-fiction: I want to do X because Y, or else Z will ruin everything.*

