

Computational Thinking

Everything Is a Number

Everything Is a Number

- Key principle: Everything Is a Number
 - Computers only work with numbers
- Hardware: **bits** (0 , 1)
 - Can only do math
- Do not need to worry about bits
 - Abstraction

Abstraction

Interface: What It Does

Implementation: How It Does It

- Abstraction:
 - Separation of **interface** + **implementation**

Abstraction

Push Gas Pedal → Car Goes Faster

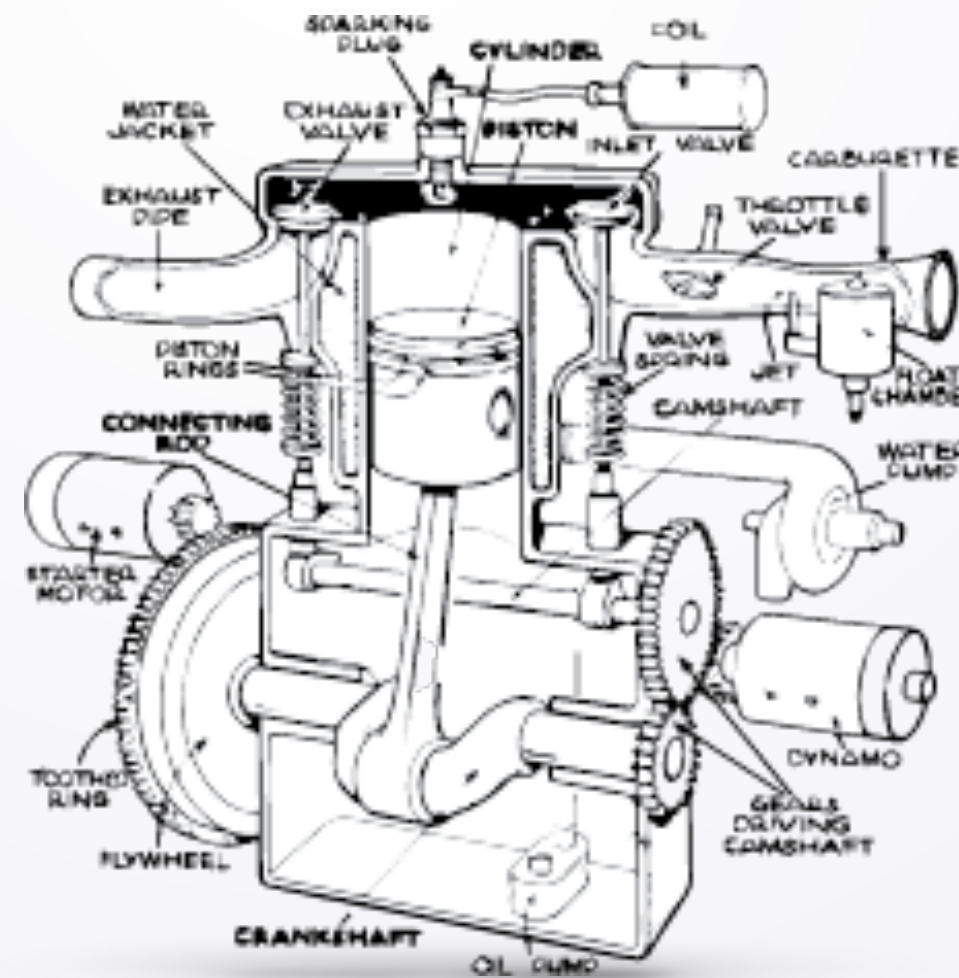
Complicated Inner Workings of Engine

- Example: Driving a Car

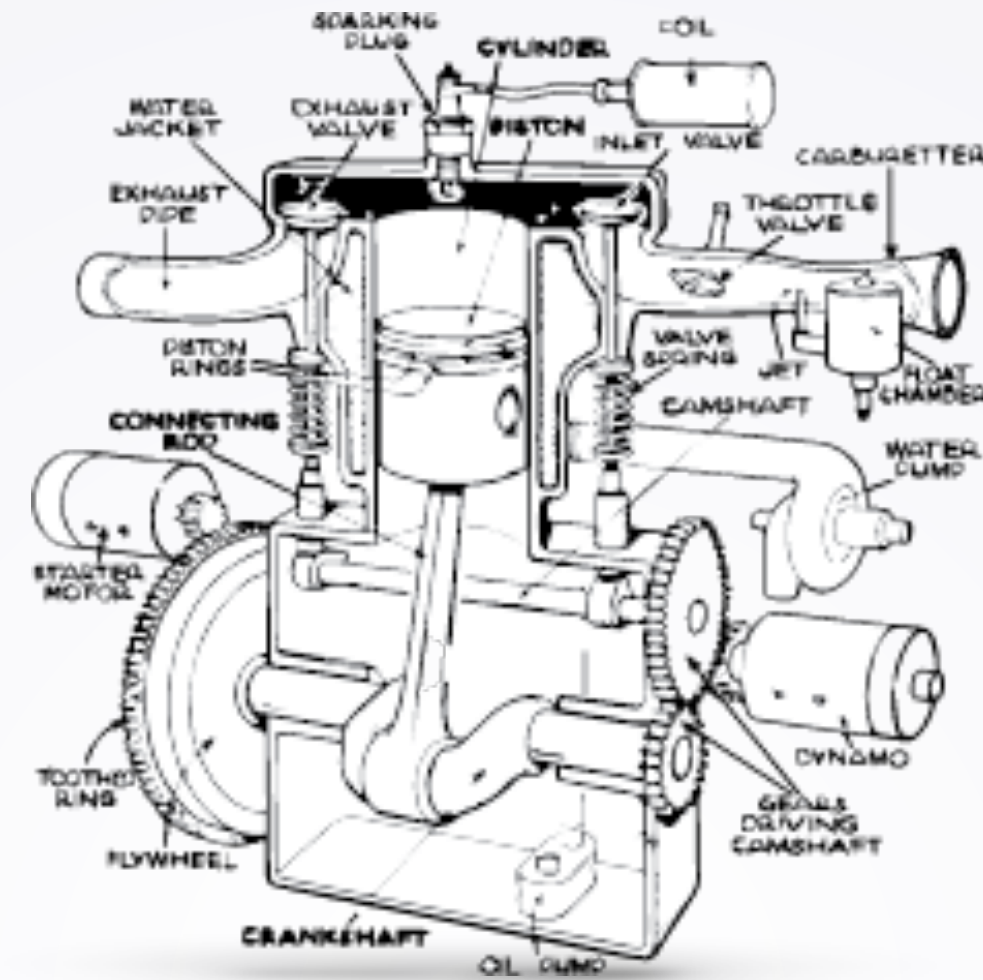
Abstraction: Multiple Layers



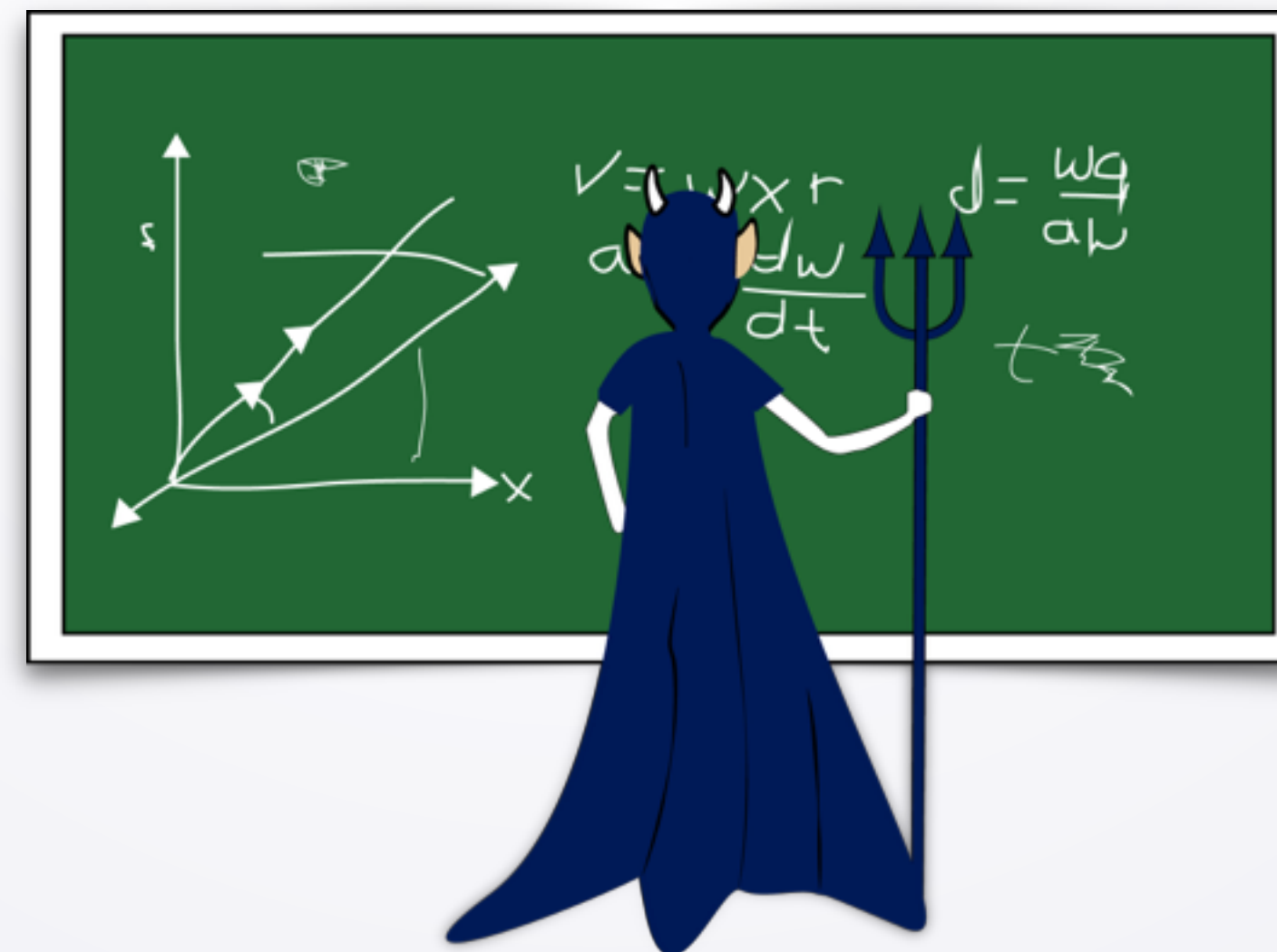
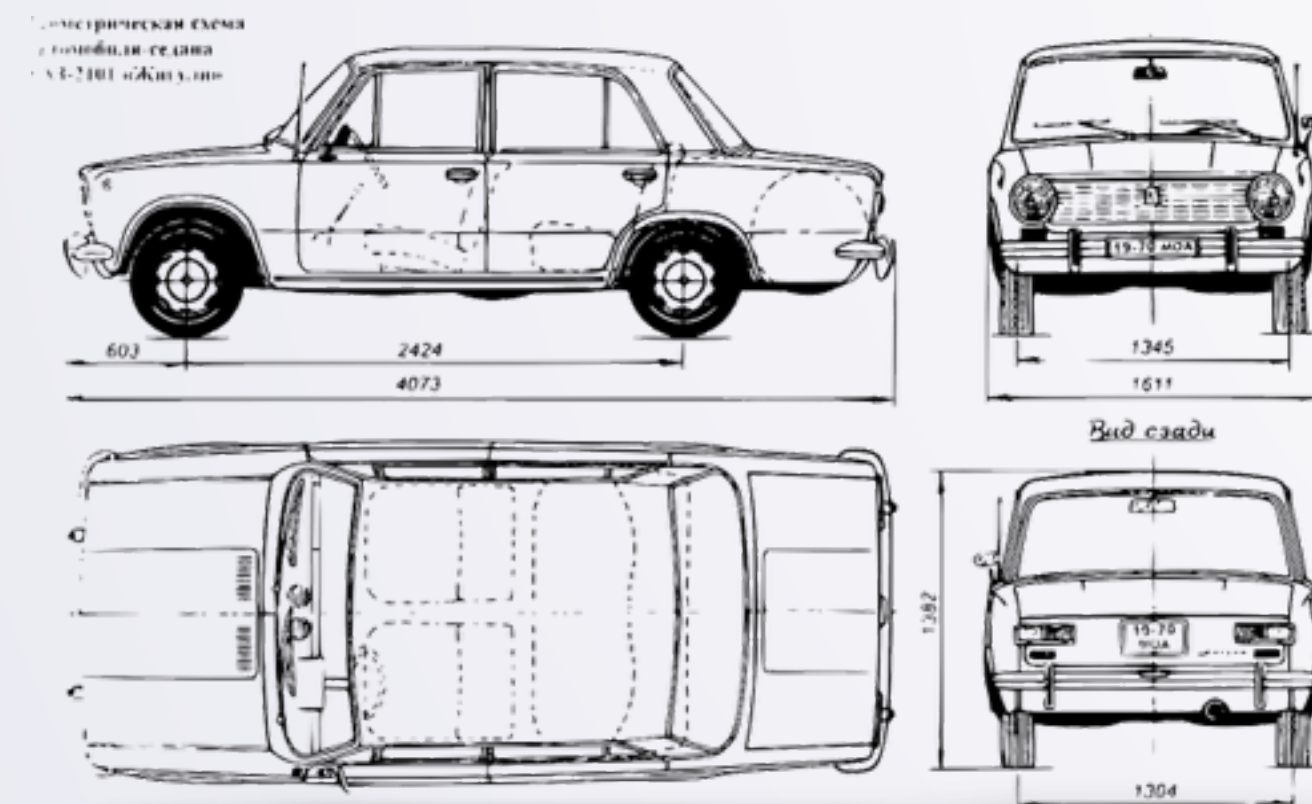
Driver



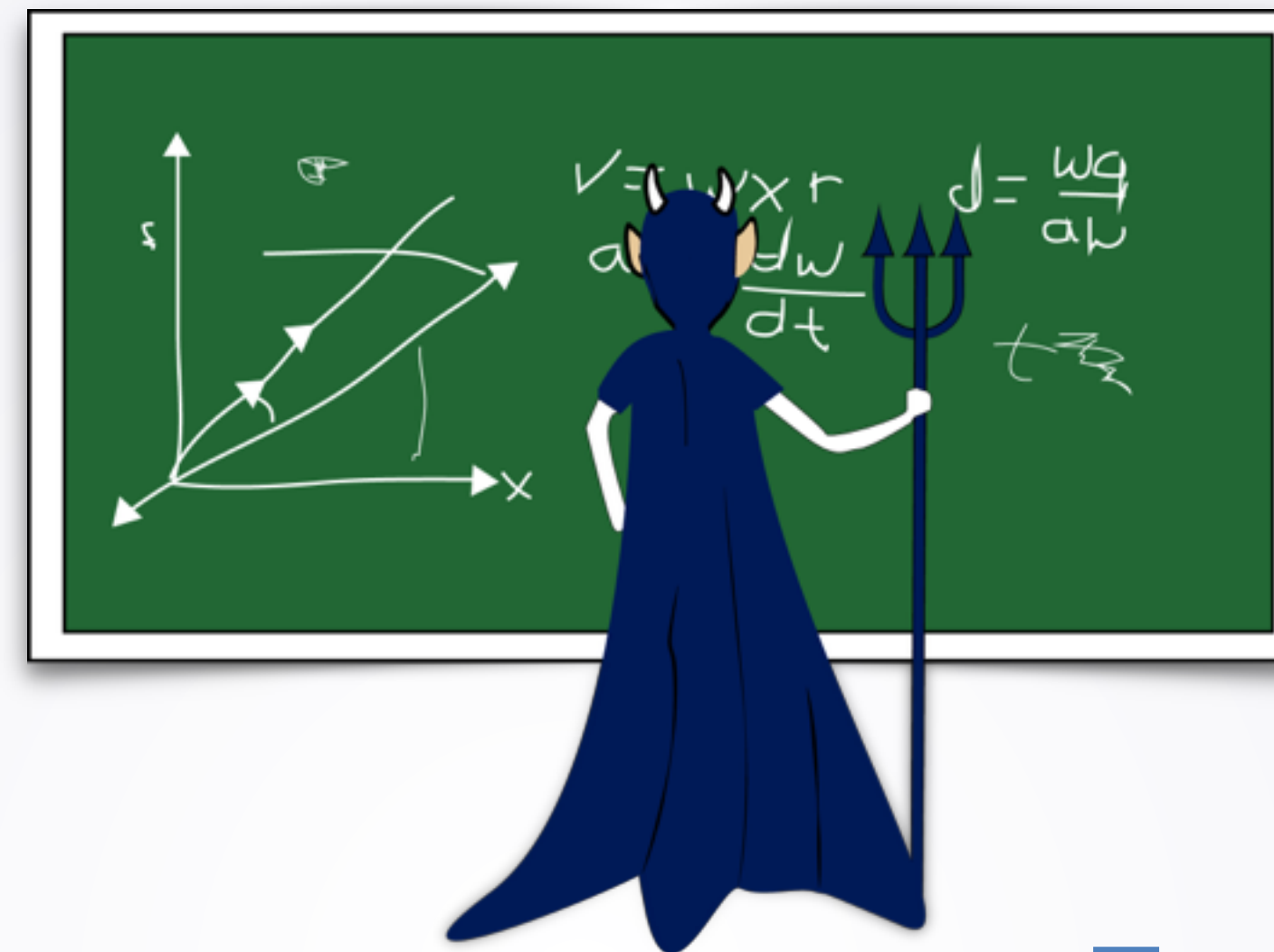
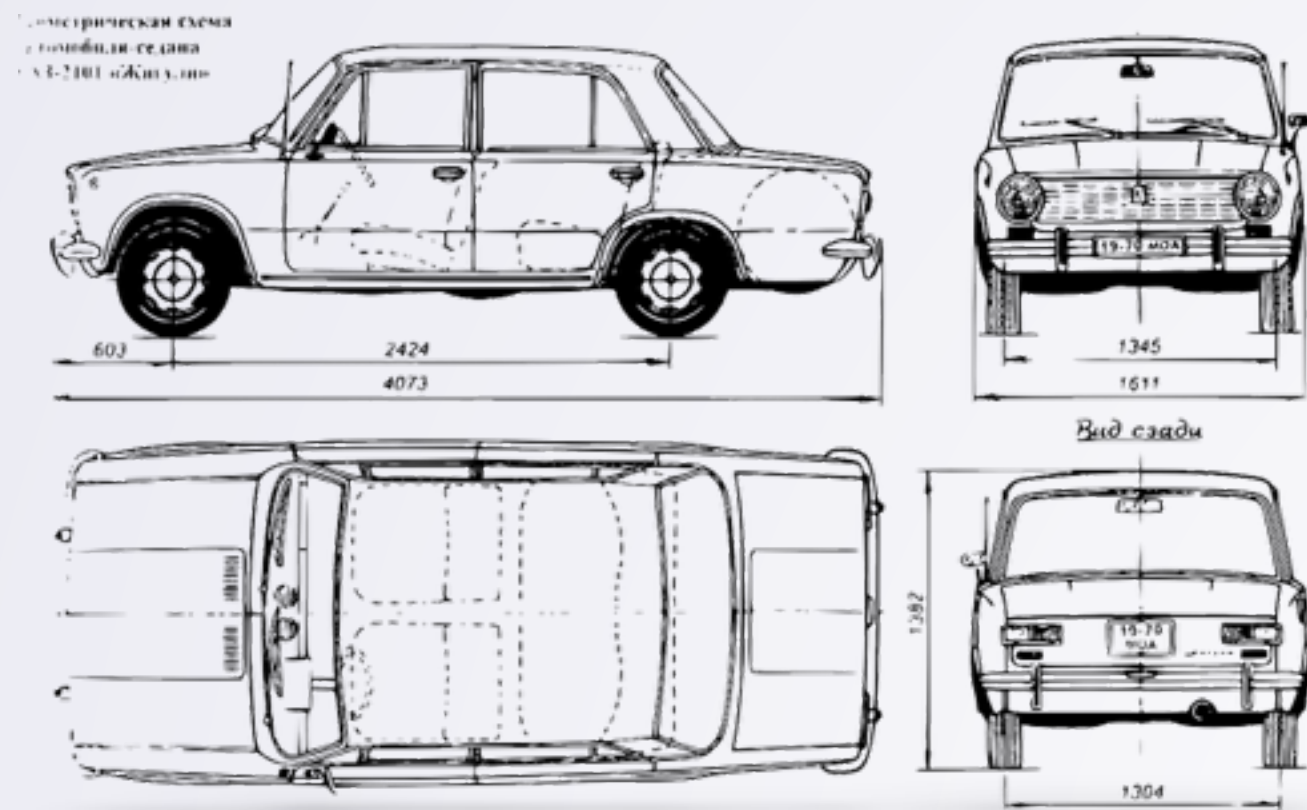
Abstraction: Multiple Layers



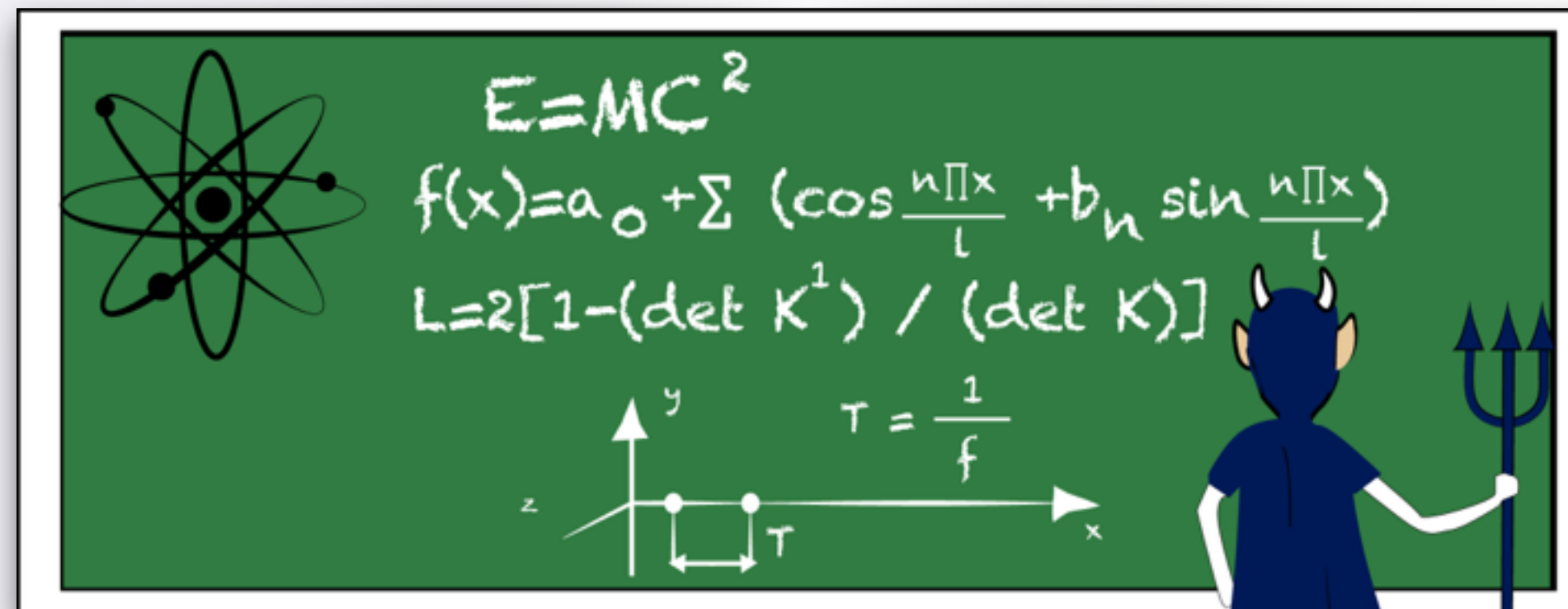
Mechanic



Abstraction: Multiple Layers



Engineer



Everything Is a Number: Characters

- Letters?
 - Could do $a=1, b=2, \dots$
- Actually **characters**
 - $A=65, B=66, \dots$
 - $a=97, b=98, \dots$
 - $!=33$

Everything Is a Number: Characters

- Letters?
 - Could do $a=1$, $b=2$,...
- Actually **characters**

32	sp	33	!	34	"	35	#	36	\$	37	%	38	&	39	'
40	(	41	)	42	*	43	+	44	,	45	-	46	.	47	/
48	0	49	1	50	2	51	3	52	4	53	5	54	6	55	7
56	8	57	9	58	:	59	;	60	<	61	=	62	>	63	?
64	@	65	A	66	B	67	C	68	D	69	E	70	F	71	G
72	H	73	I	74	J	75	K	76	L	77	M	78	N	79	O
80	P	81	Q	82	R	83	S	84	T	85	U	86	V	87	W
88	X	89	Y	90	Z	91	[	92	\	93	]	94	^	95	_
96	`	97	a	98	b	99	c	100	d	101	e	102	f	103	g
104	h	105	i	106	j	107	k	108	l	109	m	110	n	111	o
112	p	113	q	114	r	115	s	116	t	117	u	118	v	119	w
120	x	121	y	122	z	123	{	124		125	}	126	~	127	del

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- Letters?
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 - $!=33$
- Do not need to know specific numbers!
 - Abstraction

Strings: Sequences of Characters

- String: sequence of characters
 - "Hello!"
- Come up often in CS
 - Have seen in HTML

Abstraction: Strings

“Hello!”

72 101 108 108 111 33

- Write “Hello!”
 - Rarely think about numeric implementation

Importance of Everything Is a Number

- Can expose numeric properties
 - Math with letters? Cryptography
- **Types:** interpretation of numbers
 - How to operate on values?
 - $"1" + "1" = "11"$
 - $1 + 1 = 2$
- Represent data numerically
 - Maybe with existing types

Programs: Also Numbers

- Programs: also numbers
 - Starts out as a string
 - Turned into **instructions**
 - Numerical encoding of what to do
- Importance:
 - Can download, run new programs
 - Security issues (advanced concepts!)
- As always: abstraction!

Everything Is a Number

- Everything Is a Number
 - Computers do math
 - Abstraction: interface vs. implementation
 - May not “see” numeric details