

## Mission Critical Systems

Mars Rovers - \$2.5B budget  
10 years (so far)

software updates

26B flash

500 bps to 32 kbps

<https://marsmobile.jpl.nasa.gov/msl/mission/communicationwithearth/data/>

several days to send 26B

(orbiter can't communicate  
w/ Earth 24/7)

<https://shemesh.larc.nasa.gov/fm/>

## Therac-25

radiation therapy machine

hardware interlocking mechanism replaced with <sup>buggy</sup> software

3 people died

Statements

statement: a sentence that is either true or false

Avelo flies to New Haven. T

Southwest flies to White Plains. F

(and x y)

The airline is bankrupt. not a statement  
what airline??

compound statement: built from simpler statements using conjunctions like and, or

Avelo flies to Bradley and Spirit flies to BWI

United flies to Providence or American flies to New Haven

^ and  
v or  
↑

statement form: replace simple statements w/ variables conjunctions with symbols

a = "AA flies to AUS"  
 b = "XP flies to BWI"  
 o = "UA flies to OAK"  
 s = "UA flies to SFO"  
 t = "B6 flies to TUL"  
 y = "UA flies to YHM"

AA flies to AUS or UA flies to SFO  
 $a \vee s$

XP flies to BWI and AA flies to AUS  
 $b \wedge a$

Either B6 flies to TUL and XP flies to BWI, or UA flies to SFO  
 $(t \wedge b) \vee s$

B6 flies to TUL and either XP flies to BWI or UA flies to SFO  
 $t \wedge (b \vee s)$

precedence:  $\neg$   $\vee$   $\wedge$   $\rightarrow$   $\leftrightarrow$

UA does not fly to OAK  $\neg o$   $\rightarrow$  O

$\neg a \vee b$   
 equiv to  $(\neg a) \vee b$

UA flies to SFO but not to OAK.  
 $s \wedge \neg o$

UA flies to neither OAK nor YHM.  
 $\neg o \wedge \neg y$

Let x =

$$1 < x \leq 8$$

P = "  
 Q = "