Lecture 2

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Sept 3, 2019

Administrivia

- Location for my OH --- see course website
  - Today 212 Cory
- Round tables --- overwhelming response
- Jupyter notebooks
- HW policy
  - 80% correct to get full credit
- Discussions start tomorrow
  - Freshmen, junior transfers, linear algebra experience, 2-hour session, session for underrepresented students, general sessions

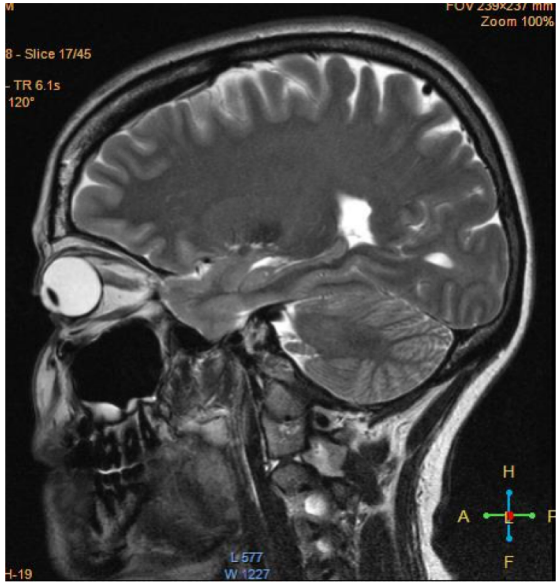
	Monday		
9:00 AM	(207: Barrows 60): Ricky (CS Scholars)		
10:00 AM	(202: Cory 521): Kareem	(221: Wheeler 20): Nirmaan	(211: Mulford 240): Moses
11:00 AM	(208: Barrows 140): Nirmaan		
12:00 PM	(204: Cory 241): Grace	(201: Wheeler 222): Alice	(214: Barrows 60): Deepshika
1:00 PM		(216: Barrows 60): Miyuki	(209: Barrows 140): Michelle
2:00 PM	(205: Cory 247): Ryan	(210: Cory 521): Deepshika	(218: Donner Lab 155): Panos
3:00 PM	(215: Etcheverry 3113): Terry	(212: Cory 521): Jesse	(213: Etcheverry 3109): Alice
4:00 PM	(203: Cory 521): Miyuki	(206: Etcheverry 3113): Jack	
5:00 PM	(223: Barrows 140): Panos	(222: Barrows 56): Christos	(224: Barrows 60): Ricky

Wednesday		
(207: Barrows 60): Ricky (CS Scholars)		
(202: Cory 521): Kareem	(221: Wheeler 20): Craig	(211: Mulford 240): Moses
(208: Barrows 140): Craig		
(204: Cory 241): Sam	(201: Wheeler 222): Alice	(214: Barrows 60): Sarika
	(216: Barrows 60): Anika	(209: Barrows 140): Michelle
(205: Cory 247): Ryan	(210: Cory 521): Sarika	(218: Donner Lab 155): Panos
(215: Etcheverry 3113): Terry	(212: Cory 521): Jesse	(213: Etcheverry 3109): Alice
(203: Cory 521): Anika	(206: Etcheverry 3113): Jack	
(223: Barrows 140): Panos	(222: Barrows 56): Christos	(224: Barrows 60): Ricky

Today

- Imaging lab
- Recovery from superposition
- Systems of linear equations
- Question last time
  - Unique solution?
  - No solutions?
  - Infinitely many solutions?
- Gaussian Elimination

Tomography

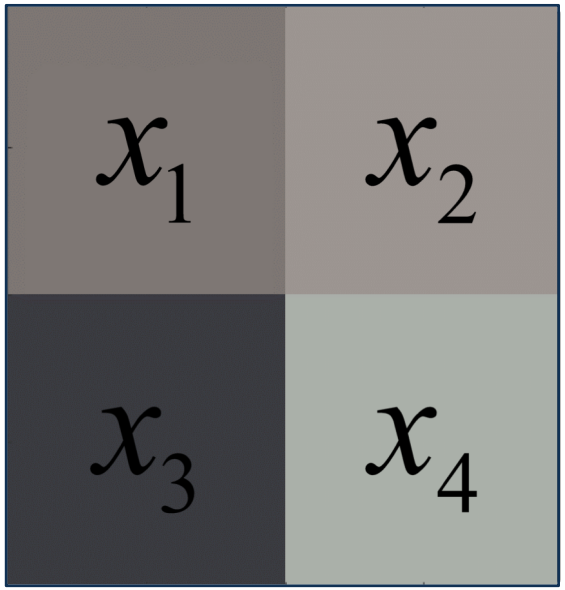


‘tomo’ – slice

‘graphy’ – to write

Assume it is not desirable to slice open my brain. How does tomography ‘see’ inside?

Example: Tomography



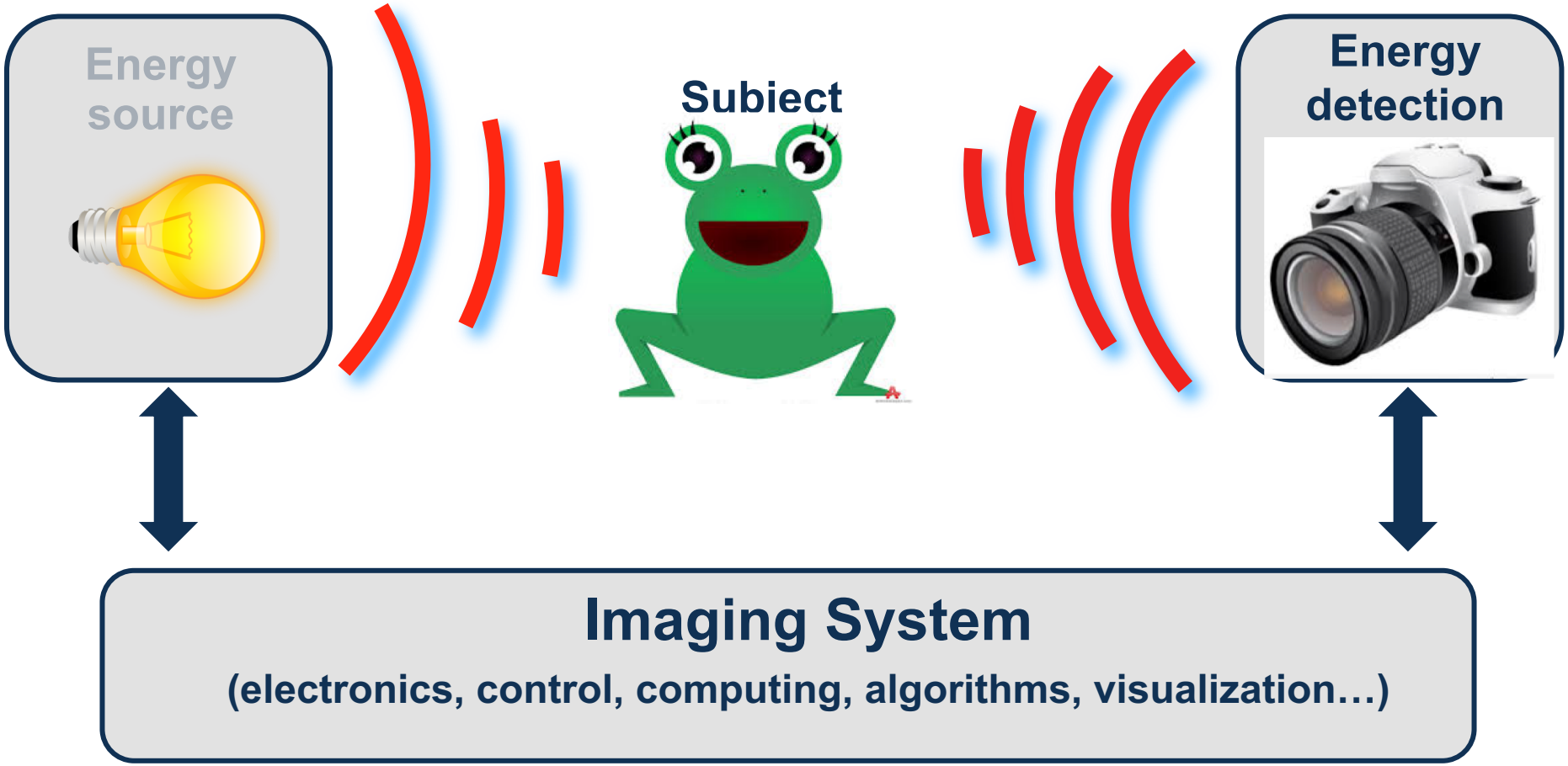
What do pixel values represent?

e.g. density, absorption, etc.

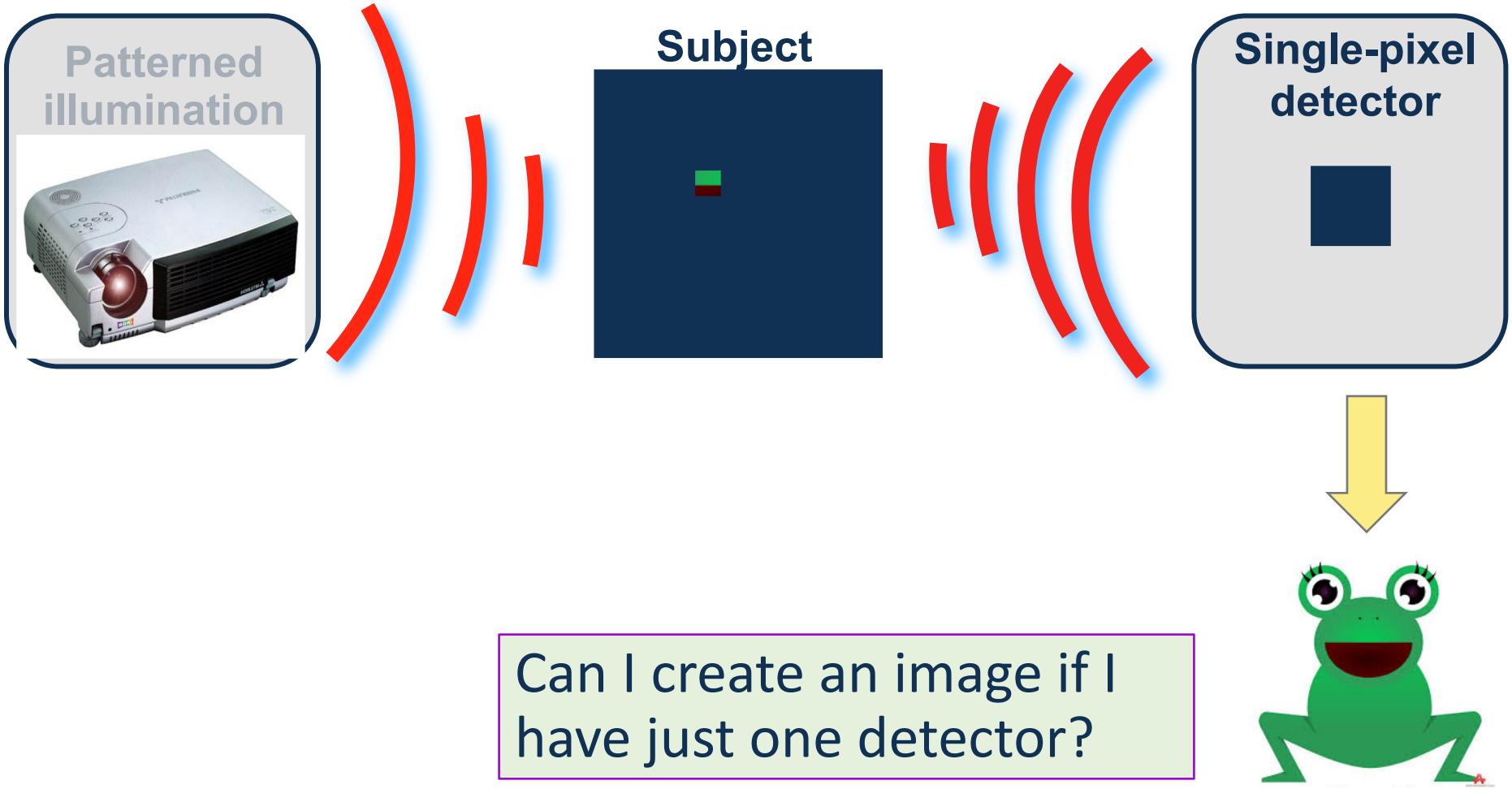
Can we solve for the pixel values from projections?

Yes, with tomography.

Imaging in general

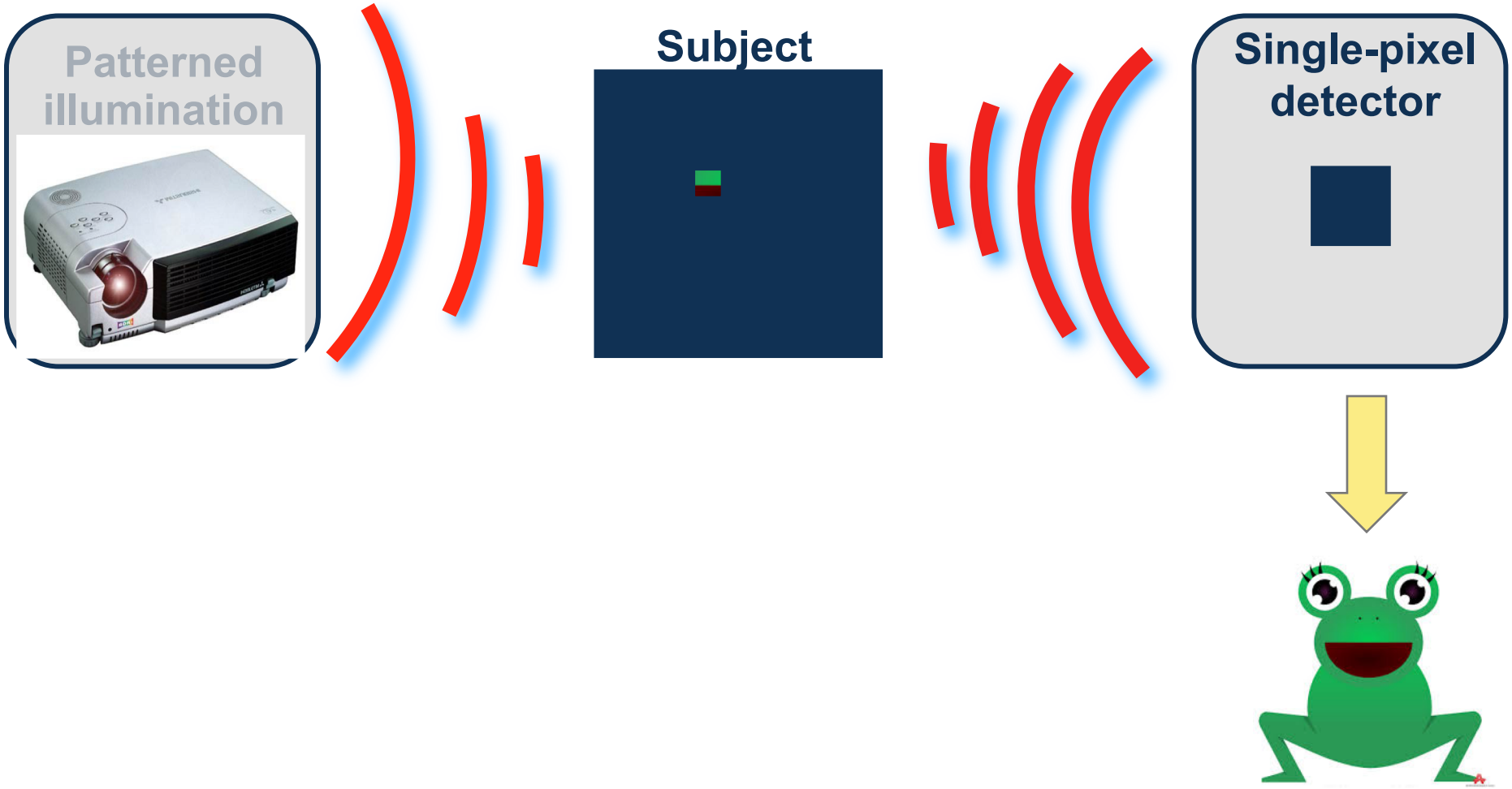


Single-pixel camera

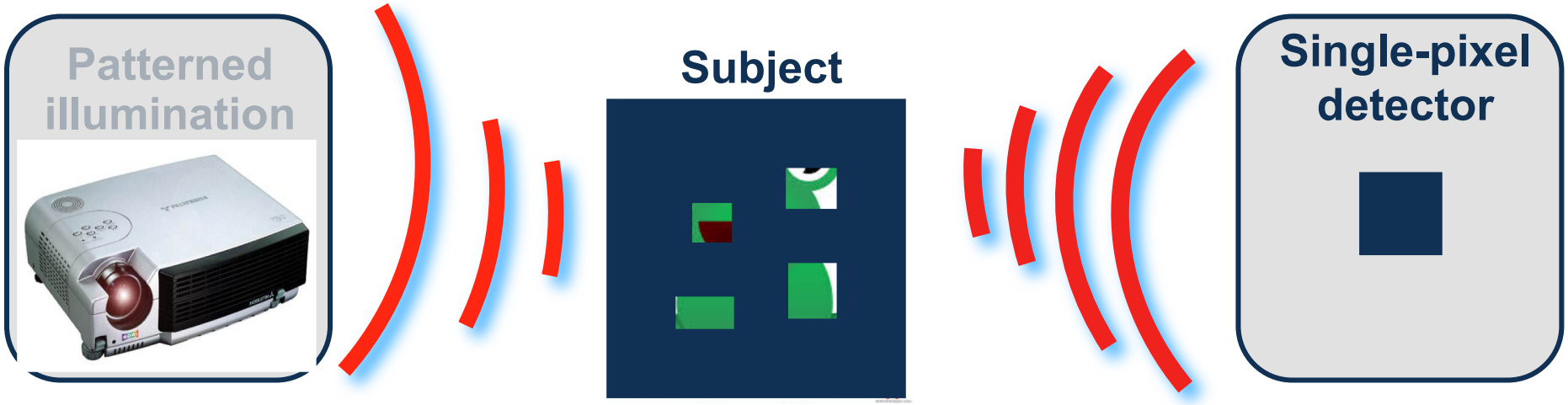


Can I create an image if I have just one detector?

Single-pixel camera



Single-pixel camera

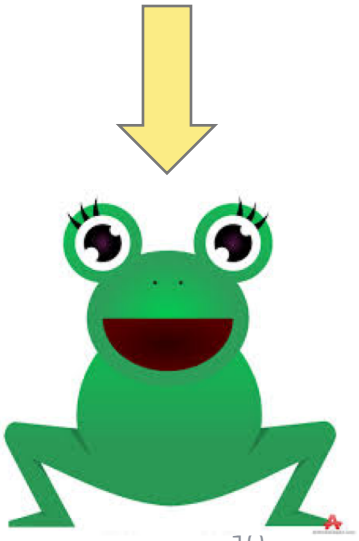


Can we recover the frog?

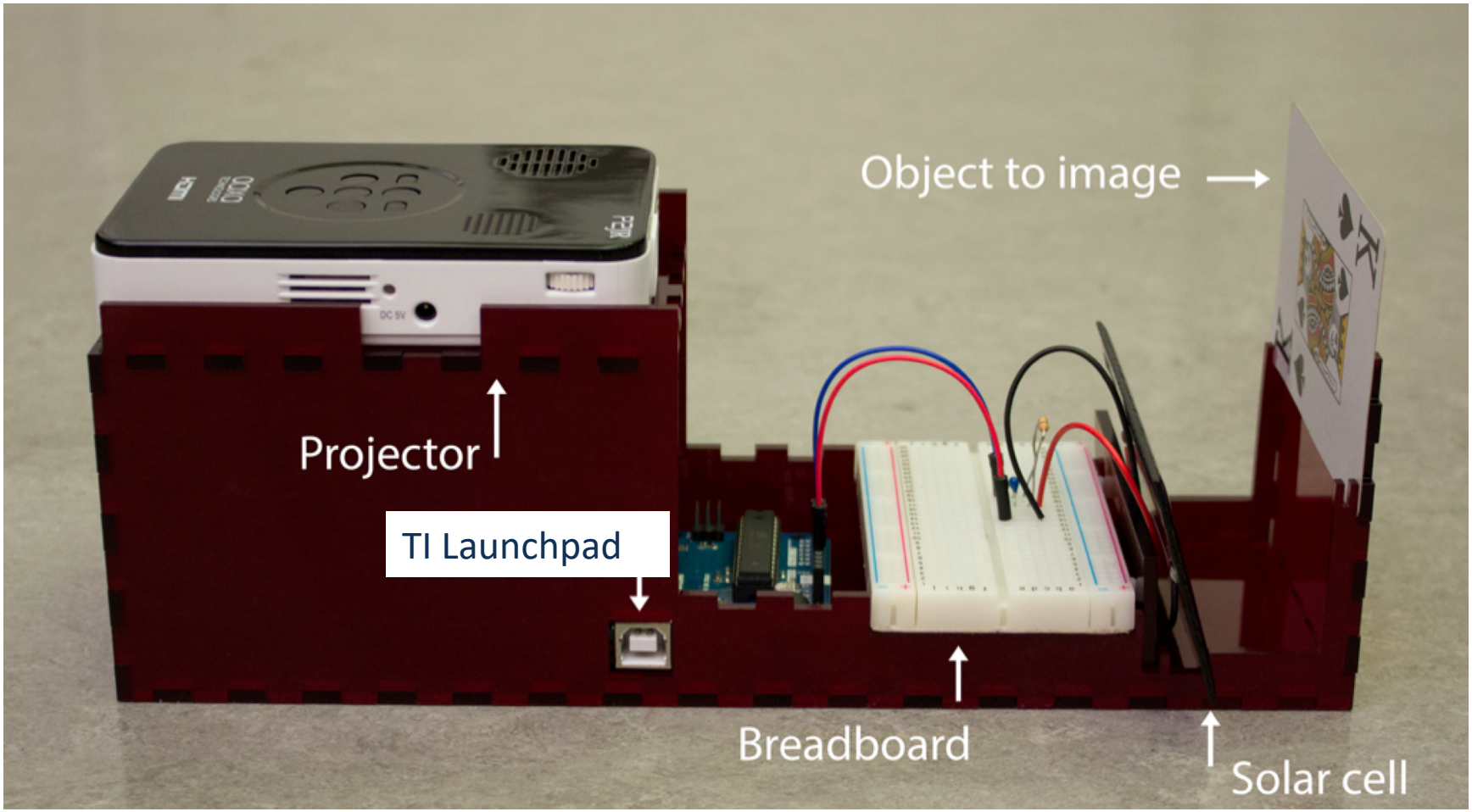
How many measurements do I need?

How should I choose illumination patterns?

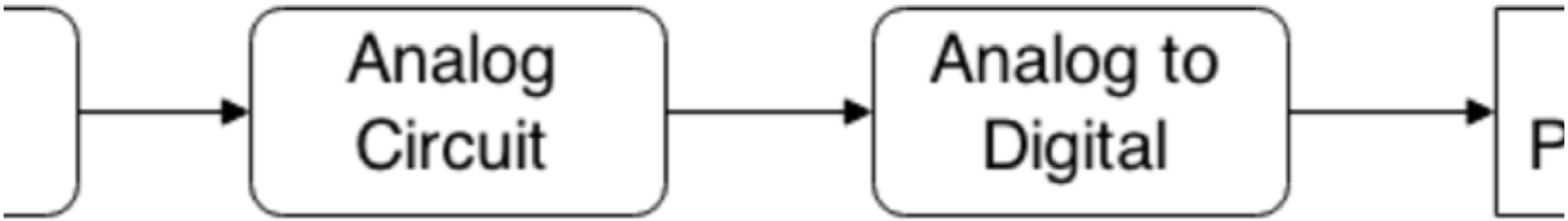
What are “good” measurements?

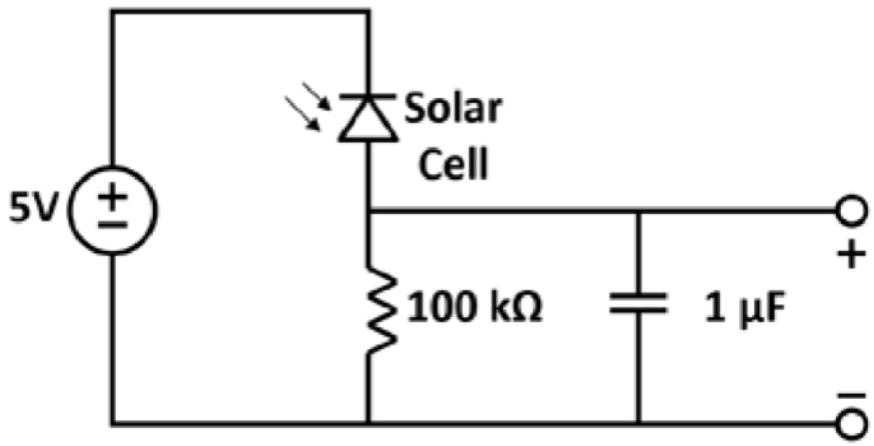


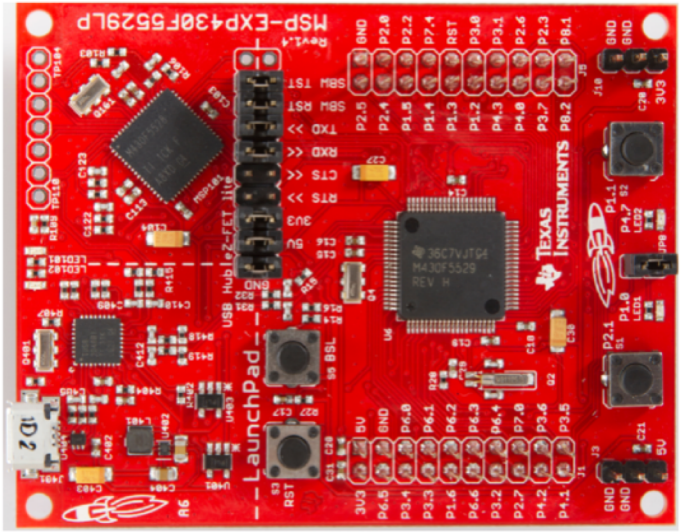
Imaging Lab #1 Setup



Imaging Lab #1







Gaussian Elimination

- n variables and m equations
- Start with row $i=1$
- Swap rows to get equation with variable x_i in row i
- Multiply/divide row i so that the coefficient of x_i in that row is 1
- For all rows $j = i+1$ to m,
  - Use i^{th} row to cancel x_i from row j
- Get upper-triangular matrix
- Backsubstitute

Permitted operations

- Multiply a row by a non-zero scalar
- Swap two rows
- Add a scalar multiple of one row to another row

Stopping conditions

In augmented matrix form

- Row of all zeros --- infinite solutions
- Row of all zeros except last entry in augmented matrix --- no solutions
- Row with all zeros and a one at the end, followed by the entry in the augmented column --- unique solution