What do I know about good pictures?

- Not much: amateur photographer, wildlife, travel, portrait
I like equipment

• I am a geek!

• Also I teach
  6.815 Digital and Computational Photography
  6.865 Advanced Computational Photography
Plan

• Imaging parameters
  – Camera
  – Lighting
  – Software

• Equipment

• Improving your pictures
Slides are online

- http://people.csail.mit.edu/fredo/
- More material at
  - http://graphics.stanford.edu/courses/#cs178
Imaging parameters

Fredo Durand
MIT CSAIL
Imaging parameters

- Focal length
  - Sensor format
- Shutter speed
- Aperture
- ISO
  - Noise, sensor size
- Lighting
- Software
Focal length = field of view

• zooming changes the focal length

24mm

50mm

135mm
Focal length = cropping

- 24mm
- 50mm
- 135mm
Focal length vs. viewpoint

- Telephoto makes it easier to select background (a small change in viewpoint is a big change in background.)
Perspective vs. viewpoint

- Portrait: distortion with wide angle
- Why?

Wide angle

Standard

Telephoto
Very wide angle: include but distort

- Difficult lens to use because it includes so much
- enables wide range of scales
Normal: neutral

50mm

55mm

50mm

Monday, May 2, 2011
Medium telephoto: isolate

95mm

110mm

150mm
Super telephoto

910mm

910mm

910mm

390mm
Focal length & sensor

- What happens when the sensor is half the size?
  - It’s like cropping!
  - The field of view is reduced by a factor of 2
  - The equivalent focal length for is multiplied by 2
  - Hence the so-called crop factor, and the notion of 35mm equivalent focal length

- Most affordable SLRs have a 1.5 crop factor
36x24mm (35mm format)

28.7x19.1mm (EOS 1D) = 1.26x magnification factor

APS-C sized sensors (EOS 10D, Nikon D100, Pentax *ist D, etc) = 1.5x - 1.6x

18x13.5mm (4/3" system - Olympus E-1)

8.8x6.6mm (2/3" P&S)

8.8x6.6mm (2/3")

7.2x5.3mm (1/1.8")

5.3x4mm (1/2.7")
Consequences of smaller sensor

- Different field of view for same focal length
  - hence the “crop factor”
  - a 100mm on a low-end SLR has the same field of view as a 150mm on a high-end one

- Larger depth of field

- Increased noise
Recap: focal length

• focal length
  = field of view
  = cropping

• depends on sensor size

• zooming changes the focal length
  – wide angle: <35mm
  – telephoto: > 85mm

• difference between viewpoint and focal length
Exposure

• Get the right amount of light to sensor/film

• Two main parameters:
  – Shutter speed
  – Aperture (area of lens)

+ sensor/film sensitivity (ISO)

Main side effects
  – motion blur
  – depth of field
Main effect of shutter speed

• Motion blur

From Photography, London et al.
Effect of shutter speed

- Freezing motion

Walking people  1/125
Running people  1/250
Car  1/500
Fast train  1/1000

Note: it doesn’t mean that shutter speed is proportional to the speed of the object. A photographer usually tracks the subject.
Slow shutter speed for motion blur

0.8s
Tracking & slow shutter speed
Slow shutter speed to get light

15s
Aperture

- Diameter of the lens opening (controlled by diaphragm)
- Expressed as a fraction of focal length, in f-number
  - f/2.0 on a 50mm means that the aperture is 25mm
  - f/2.0 on a 100mm means that the aperture is 50mm
- Disconcerting: small f number = big aperture
- What happens to the area of the aperture when going from f/2.0 to f/4.0? divided by 4 (square of f number ratio)
- Typical f numbers are f/2.0, f/2.8, f/4, f/5.6, f/8, f/11, f/16, f/22, f/32
  - See the pattern?
Depth of field

- Pixel is an integral over a cone of light
  - Converges at focal plane
  - But blurs for other distances
Depth of field

• What happens when we close the aperture by two stop?
  
  – Aperture diameter is divided by two
  – Depth of field is doubled
Depth of field

From Photography, London et al.
Is depth of field good or evil?

- It depends, little grasshopper
- Want huge DoF: landscape, photojournalists, portrait with environment
- Shallow DoF: portrait, wildlife

Michael Reichman

Steve McCurry
Shallow depth of field: portrait

85mm f/1.2
Depth of field

• It’s all about the size of the lens aperture

![Diagram showing depth of field](image)
Depth of field & sensor

- Nikon D3s: 36x24mm
Depth of field & sensor

- Sony DSC-TX9: 6.17 x 4.55 mm
Small sensors => large depth of field

- [http://www.mediachance.com/dvdlab/dof/index.htm](http://www.mediachance.com/dvdlab/dof/index.htm)
Exposure

• Two main parameters:
  – Aperture (in f stop)
  – Shutter speed (in fraction of a second)

• Reciprocity

  The same exposure is obtained with
  an exposure twice as long and an
  aperture area half as big

  – Hence square root of two progression of f stops
    vs. power of two progression of shutter speed
  – Reciprocity can fail for very long exposures

From Photography, London et al.
Reciprocity

• Assume we know how much light we need
• We have the choice of an infinity of shutter speed/aperture pairs

• What will guide our choice of a shutter speed?
  – Freeze motion vs. motion blur, camera shake
• What will guide our choice of an aperture?
  – Depth of field, diffraction limit
• Often we must compromise
  – Open more to enable faster speed (but shallow DoF)
Small aperture (deep depth of field), slow shutter speed (motion blurred). In the scene, a small aperture (f/16) produced great depth of field; the nearest paving stones as well as the farthest trees are sharp. But to admit enough light, a slow shutter speed (1/8 sec) was needed; it was too slow to show moving pigeons sharp. It also meant that a tripod had to be used to hold the camera steady.

From Photography, London et al.
Medium aperture (moderate depth of field), medium shutter speed (some motion sharp). A medium aperture (f/4) and shutter speed (1/125 sec) sacrifice some background detail to produce recognizable images of the birds. But the exposure is still too long to show the motion of the birds' wings sharply.

From Photography, London et al.
Large aperture (shallow depth of field), fast shutter speed (motion sharp). A fast shutter speed (1/500 sec) stops the motion of the pigeons so completely that the flapping wings are frozen. But the wide aperture (f/2) needed gives so little depth of field that the background is now out of focus.

From Photography, London et al.
Exposure modes

• Aperture priority: A (My favorite, I use it 90% of the time)
  – Direct depth of field control
  – Cons: can require impossible shutter speed (e.g. with f/1.4 for a bright scene)

• Shutter speed priority: Tv or S
  – Direct motion blur control
  – Cons: can require impossible aperture (e.g. when requesting a 1/1000 speed for a dark scene)
    • Note that aperture is somewhat more restricted

• Program
  – Almost no control, but no need for neurons

• Manual
  – Full control, but takes more time and thinking
Sensitivity (ISO)

• Third variable for exposure
• Linear effect (200 ISO needs half the light as 100 ISO)
• Trade sensitivity for noise

http://wiegaertnerfilms.com/tutorials/the-best-iso-settings-for-canon-video-dslrs/
Demo

Plan

• Imaging parameters
  – Camera
  – Lighting
  – Software

• Equipment

• Improving your pictures
Light

Bad light
Light

• Control light
  – Time of day
  – Location, direction
  – Add light (flash)
  – Reflect light

• Goals
  – Control contrast
  – Shape modeling
  – Story telling, art
Studio Lighting

• E.g. 3-point lighting
  – Reduce dynamic range
  – Emphasize silhouettes
  => 3D cues

• Goals of lighting:
  – Manage dynamic range
  – Reveal shape, layout, material
  – Tell story
Bottom line

- Don't get married on a sunny day!
Go in the shade

- Light is more diffuse

Bad

Better
Overcast days are the best

- Just don’t put the sky in the frame

The weather conditions

The pictures

Other overcast-day pictures
Best time of day: sunset & sunrise

- +/- 1 hour
- “Golden hours”
- Night photography: always near sunset/sunrise
  - because of nice diffuse light

<table>
<thead>
<tr>
<th>Mid day: often not great</th>
<th>less than 1 hour after sunrise/ before sunset</th>
<th>During sunset or sunrise</th>
<th>After sunset</th>
</tr>
</thead>
</table>

Monday, May 2, 2011
During sunset/sunrise

less than 1 hour after sunrise

After sunset
• 10 minutes after sunset
Add fill flash

- For harsh lighting conditions
- Illuminate shadows with flash to reduce dynamic range
- But set the flash to -1.5 or -2 EV (3 to 4 times darker than existing lighting)

With fill flash
Flash as the main light source

Problems:
- poor location,
  no shape modeling
- small light source
- annoying shadows
- often, too white compared to available light
Solution: bounce flash

- Ceiling bounce: much better, more diffuse
- Disadvantage: shadows under the eyes
Solution: wall bounce flash

• Better shape modeling (light from the side), good lighting of the eyes
• Disadvantage: walls not always white
Flash Diffuser

• Two tricks:
  – diffuser illuminates the whole room, light is very diffuse but also illuminates directly
  – diffuser is orange and matches ambient light
Reflect light

See the difference a reflector can make.

http://studiostyles.net/location-lighting-techniques-finding-the-light/
Recap: Light

• Control light
  – Time of day
  – Location, direction
  – Add light (flash)
  – Reflect light

• Goals
  – Control contrast
  – Shape modeling
  – Story telling, art
Plan

• **Imaging parameters**
  – Camera
  – Lighting
  – Software

• **Equipment**

• **Improving your pictures**
Software

- Software adjustment can make a big difference!

Before

After

Here:
exposure
curve
clarity
vibrance
Software

• Shoot in RAW for more flexibility
• Photo management & lightweight editing
  – Lightroom, Aperture, Lightzone, Darktable
  – Fix white balance (make white white!)
  – Adjust exposure (e.g. brighter for snow scene)
  – Crop to improve composition
  – Manage contrast using the curve
  – Boost saturation (or vibrance) a little.
  – Add light to dark areas (fill light)
  – Sharpen a bit
  – Convert to black and white
• Use Photoshop only if you really need to
White balance

• Party name tags provide excellent white references!
Exposure correction

• I told the camera to make the image 1.8 times brighter
• Still too dark
Exposure correction

• I told the camera to make the image 1.8 times brighter
• I still had to brighten it in software
Manage contrast with the curve

• Before curve adjustment
Manage contrast with the curve

• After curve adjustment (a tad overdone)
Boost saturation or vibrance

• Before
Boost saturation or vibrance

• After
Fill light

• Before fill light
Fill light

- After fill light
Graduated filter

Before
Graduated filter

Darken sky

After

Brighten ground
Black and white

• Helps when colors are distracting
Black and white

- Often needs to boost contrast
Other useful tools/sliders

• Black point
• Recovery (to save clipped highlights)
• Denoising
• Clarity
• Local adjustments and gradient
• Vignetting
• Optical aberration correction
• Perspective correction
Organize, rate, delete

- On a photo trip, I keep 1% of pictures
  - That’s also the rate of most pros
  - Yes, I shoot more photos than most people
  - But I also keep a lot fewer
Organize, rate, delete

• My strategy: multipass algorithm
  – Go through all pictures, and rate the OK ones 1 star
  – Go through the 1 star and rate the better ones 2 stars
  – Etc.
If you’re really good

• Keyword your pictures
Software ++

- Stitch panoramas
- High-Dynamic-Range
- Multiple exposures
- Macro focal stack
Recap: Software

• Shoot in RAW for more flexibility
• Photo management & lightweight editing
  – Lightroom, Aperture, Lightzone, Darktable
  – Fix white balance (make white white!)
  – Adjust exposure (e.g. brighter for snow scene)
  – Crop to improve composition
  – Manage contrast using the curve
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  – Add light to dark areas (fill light)
  – Sharpen a bit
  – Convert to black and white
• Use Photoshop only if you really need to
Plan

- Imaging parameters
  - Camera
  - Lighting
  - Software

• Equipment

• Improving your pictures
Equipment

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Choosing a camera

- If you can afford it, get an SLR
  - bigger sensor = less noise in low light
  - bigger sensor = shallower depth of field
  - faster autofocus
  - more lens choice, higher optical quality

- Do not worry about
  - megapixels - 6 is way enough
  - brand - they’re all good enough
  - body - they all have the same image quality

- Worry about lenses
- Worry about lighting gear (cheap and effective)
Lens quality varies!

source: the luminous landscape

Monday, May 2, 2011
Zoom vs. prime

- The left image is with an expensive zoom
- Still softer than the prime on the right

source: the luminous landscape
Online reviews

Equipment

• Do get an SLR or mirrorless, compacts are too limited
• Don't worry about brand (with a bias for Nikon/Canon/Sony)
• Don't worry about the body, get the cheapest one
• Worry about lenses
  – Zooms are convenient but quality can be a problem
    • Avoid large range (e.g. 18-200) they’re not bad when stopped down, but quality isn’t great at full aperture
    • Maximum aperture matters (the smaller the number, the better)
  – Get a prime in the 35-85mm range
    (cheap, high quality, wide aperture) 50mm f/1.8
• Count $500 to 1k for basic configuration
Equipment: accessories

- Good flash photography is very difficult!
  – Because you typically deal with 2 sources of light: flash and ambient
  – You need to get the exposure right for both!
  – You need to get the white balance right for both!
- Get an external flash if you want to take “event” pictures
  – The built-in flash is only good for fill flash (in bright sunlight)
  – Use external flash, orient towards (white) wall/ceiling
  – Get a diffuser (omnibounce)
  – Get yellow gel (or diffuser) to match indoor lighting
- Get a tripod
  – important for landscape, cityscape
  – get a good one: stability is important
Nikon

Tends to be a tad cheaper
• D3100 & D5100 are good. D7000 if you want to be more serious
• 18-70 or 17-55 f/2.8
• 55-200 is surprisingly not so bad and super cheap
• Get the new 50mm f/1.8 (the old one won’t focus)
Canon

- Rebel T3 or T3i for cheap options, 7D if your bank account permits
- If you get the kit lens, get IS
- 17-85 or 17-55 f/2.8
- 70-200 f/4.0 (amazing lens)
- 50mm f/1.8
- 100mm f/2.8 macro (great also for portraits)
Mirrorless systems

- e.g. micro 4/3, Sony Alpha Nex
- Smaller
- Autofocus not as good (contrast detection, not stereo)
- Sensor not quite as good yet (smaller)
- More depth of field
- No optical viewfinder

Recommendation:
- Sony Nex3 or 5
- Panasonic GF2
Other brands

Not as big a range, future not always clear (see Minolta), have been slower to get to digital SLR

- **Olympus**
  - Good system, but smaller sensor

- **Pentax**
  - Good entry camera

- **Sigma**
  - Intriguing sensor (Foveon), limited system, noise is an issue

- **Fuji**
  - One-trick pony (the sensor)
  - Nikon body

- **Sony**
  - Pretty good.
  - Lens selection not as good as Nikon/Canon
Lighting

• Cheapest way to improve your photo
• http://strobist.blogspot.com/2006/03/lighting-101.html
It’s the light that counts

- [http://fstoppers.com/iphone](http://fstoppers.com/iphone)
- Photos taken with an iphone 3GS
  - and a lot of lighting equipment

See also [http://www.youtube.com/watch?v=o063wC_SNxo&feature=player_embedded](http://www.youtube.com/watch?v=o063wC_SNxo&feature=player_embedded)
Cheap lighting-based setup

- Cheap compact with a flash hotshoe
  - and a manual mode
- Cheap lighting equipment (manual flashes)
- DIY diffusers and reflectors

- Good for
  - Portraits
  - Macro
- See
  - http://www.diyphotography.net/
  - http://strobist.blogspot.com/
Type of photo
Portrait

• Cheap body
• Wide aperture often matters (f/2.8 and below)
• 50mm f/1.8 is a must
• Invest in an external flash and lighting
  – reflector
• Depends on perspective you like:
  – 17-55 f/2.8
  – 50mm f/1.8
  – 70-200mm
  (f/2.8 if you can afford it)
Kids / action

• Good Autofocus matters. Get a slightly more expensive body
• Fast lens (wide aperture)
  – 17-55 f/2.8
  – 50mm f/1.8 (for kids)
  – 70-200 f/.8
• External flash for kids.
Landscape

• Get a cheap body
• Good tripod + remote trigger
• Polarizing filter
• lenses:
  – Large aperture does not matter.
  You want large depth of field
  – main one: 17-85 or 17-70
  – depending on style:
    • wider angle, e.g. 10-22 but include a foreground element
    • telephoto, surprisingly useful, e.g. 75-300
Wildlife

• Expensive!
• Need good autofocus and long lenses
• At least 300mm on small sensor
• A flash and a better beamer
Macro

• Easier with a smaller sensor
  – more depth of field
• 100mm macro or 60mm macro lens (1:1 magnification)
• Sturdy tripod + remote trigger
• Lighting equipment
  – reflector / diffuser (DIY)
  – flash or some external light
  – lots of DIY options
Plan

• Imaging parameters
  – Camera
  – Lighting
  – Software

• Equipment

• Improving your pictures
Improving your pictures

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Monday, May 2, 2011
Not a creativity session

• For those of us who are NOT talented photographers
• Heuristics, issues, that help get better photographs. Maybe not great photographs, but better
• If you are talented, good for you. Forget those “rules”, keep taking good photos.
Take pictures, critique your pictures

• And get them critiqued (friends, internet)
• Give yourself a theme, constraints
• Look at contests online:
  – You don’t need to enter the contest, but use the theme
  – http://www.dpreview.com/challenges/
  – http://www.dpchallenge.com/
  – http://www.fredmiranda.com/forum/
  – http://gizmodo.com/#!/shooting-challenge
Advice overview

• Simplify, avoid cluttered background
• Don’t center things
• Avoid harsh light
• White balance
• Portraits are all about the eyes
• Follow rules or really break them. No middle ground.
Fixing a cluttered background

• Change viewpoint
• Shallow depth of field
• Frame tighter
• Modify scene (move objects, add backdrop)
• Retouch (blur, desaturate, darken)
Composition/viewpoint

• Get low
  – at eye level of subject
• Avoid centering subject
  – rule of the third
• Keep horizon horizontal
Light & color

• Avoid harsh light…
  unless you want to play with shadows
• Sunrise & sunset are best
• Cloudy days are great as long as the sky is not in the picture
• For sunny days, shade areas are best
• Avoid direct flash
• HDR, tone map
Portraits: It’s all about the eyes

• Eyes should be sharp & shiny
• Be at eye level
• Make sure lighting is not harsh
• Shallow depth of field can help
• Add vignetting to focus attention
• Get the white balance right
  (maybe a little warm)
• Try Black and white
• Telephoto: isolate the subject
• Wide angle: approachable and
  include surrounding
• Don’t hesitate to over-shoot:
  bits are cheap
Landscape / architecture

- Get a foreground element
  - rock, tree, flower
- Rule of the thirds, diagonals
  - in particular for the horizon
- Don’t hesitate to zoom in
- Manage dynamic range
  - sky is always too bright
  - graduated neutral density, HDR
  - golden hours or right after sunset
- Use a polarizer
  - darkens the sky, make colors stand out
- Alignments
  - Keep horizon straight
  - For architecture, correct verticals
- Don’t be deterred by stormy weather
- Slow shutter speed for water
Background
Cluttered backgrounds are bad
Distracting background
Move your feet! (1 meter away)
Distracting background

Model: Rob Wang

Monday, May 2, 2011
Shallower depth of field

50mm f/1.8

Model: Rob Wang
Shallower depth of field

85mm f/1.2

Model: Rob Wang
Isolate using blur (Photoshop, layering)

• But maybe don’t over-do it
Clone brush/Poisson cleaning
Desaturate, darken

**Problem...**

**Background distractions**
In the chaos of a young child’s room, it is neither possible nor desirable to remove all the distractions, but toning them down would help to emphasize the main subject.

- Bronica SQ-A with 40 mm lens. ISO 64 film. Heidelberg Saphir II scanner.

**Desaturated background**
Applying Desaturate to the background, turning all the colors into gray has helped separate the girl from the numerous objects surrounding her. A large, soft-edged Brush tool was chosen and the printing mode was set to desaturation at 100 percent.

From Digital Photographer’s Handbook

Monday, May 2, 2011
Compositing & matting
Fixing a cluttered background

• Change viewpoint
• Shallow depth of field
• Frame tighter
• Modify scene (move objects, add backdrop)
• Retouch (blur, desaturate, darken)
Question?

• Recap: avoid distracting background
• Simplify, get close
Composition
Get low

• Try to be at eye level
Or really get high

• As usual, follow a rule or really break it.
The rule of thirds is a guideline developed by artists centuries ago. When the subject—or its most important element—is placed near one of the intersecting points of an imaginary grid, the viewer’s eye is led through the frame. The result is an aesthetically strong image.
Rule of the thirds
Rule of the Third
Variations of the rule of the thirds

• Golden ratio
  – Very questionable superstition
  – http://plus.maths.org/issue22/features/golden/

• Rule of the fifth

• ...

• Only one thing matters: don’t center!
Don’t center, especially for motion
Don’t center, especially for motion
Don’t center, especially for motion
... or do center
Question

• Recap:
  – avoid distracting background
  – be at eye level, get low
  – avoid centering subject
Build on diagonal lines
Warning: near-parallelism

• In particular, keep horizon level
• Use crop with rotation to fix this

Don't let lines unintentionally throw your photo off balance. When you shoot the horizon or a building, keep the straight lines level—unless you're shooting at a dramatic, intentional angle.

http://www.fotofinish.com/resources/centers/photo/takingpictures.htm

• or use bubble level on flash hot shoe
Correct perspective (perspective crop)

+ you control reflection and perspective independently
Try unusual angles

• Do or don't:
  Either perfectly vertical or at least 30 degrees

Try Unusual Angles
Be bold! Try turning your camera to 45 degrees before snapping a picture. Or instead of snapping it from eye level, kneel down or lie on the ground to get a more interesting shot.

Take a picture from an unusual angle

http://www.fotofinish.com/resources/centers/photo/takingpictures.htm
Question

• Recap:
  – avoid distracting background
  – avoid centering subject
  – get low
  – careful with alignment/horizon
Composition/viewpoint

• Get low
  – at eye level of subject
• Avoid centering subject
  – rule of the third
• Keep horizon horizontal
Light
Bottom line

- Don't get married on a sunny day!
Go in the shade

- Light is more diffuse

Bad

Better
Overcast days are the best

• Just don’t put the sky in the frame

The weather conditions

The pictures

Other overcast-day pictures
Best time of day: sunset & sunrise

• +/- 1 hour
• “Golden hours”
• Night photography: always near sunset/sunrise
  – because of nice diffuse light

Mid day: often not great
less than 1 hour after sunrise/ before sunset
During sunset or sunrise
After sunset
less than 1 hour after sunrise

After sunset
• 10 minutes after sunset
Add fill flash

• For harsh lighting conditions
• Illuminate shadows with flash to reduce dynamic range
• But set the flash to -1.5 or -2 EV (3 to 4 times darker than existing lighting)

Without flash
With fill flash
Add fill in light on faces: Photoshop
Add fill in light on faces
Illustrated here are the lighting effects produced by direct, wall bounce, ceiling bounce, and off-camera direct flash. The location and quality of the subject’s shadow changes, depending on the flash technique used. Direct flash, although sometimes necessary, produces a harsh image. Bounce flash produces softer light and softer shadows. Wall-bounce flash is similar to ceiling bounce flash with the added benefit of better revealing the subject’s shape.

Direct, on-camera flash is harsh and unflattering. Removing the flash from the camera, or bouncing the flash light from a nearby surface produces different effects. Light bounced from a ceiling, although commonly used, causes dark shadows in the eye sockets and under the nose and chin. The most successful technique indoors is to bounce light from a nearby light-colored wall.
Options for digital fill light

- Use the fill-in slider in Lightroom or camera raw
- Use an adjustment layer with a mask
  – paint the mask white only in the area to brighten.
Landscape: HDR & Tone mapping
Light

• Avoid harsh light… unless you want to play with shadows
  – Do or don't
Light & color

• Avoid harsh light…
  unless you want to play with shadows
• Sunrise & sunset are best
• Cloudy days are great as long as the sky is not in the picture
• For sunny days, shade areas are best
• Avoid direct flash
• HDR, tone map
White balance
White balance problem

• When watching a picture on screen or print, we adapt to the illuminant of the room, not that of the scene in the picture
• The eye cares more about objects’ intrinsic color, not the color of the light leaving the objects
• We need to discount the color of the light source

*Same object, different illuminants*
Von Kries adaptation

• Multiply each channel by a gain factor
• Note that the light source could have a more complex effect
  – Arbitrary 3x3 matrix
  – More complex spectrum transformation

http://www.cambridgeincolour.com/tutorials/white-balance.htm
Best way to do white balance

• Grey card:
• Take a picture of a neutral object (white or gray)
• Deduce the weight of each channel
• If the object is recorded as $r_w$, $g_w$, $b_w$
  use weights $k/r_w$, $k/g_w$, $k/b_w$
where $k$ controls the exposure
Lightroom demo

- Most photo editing software lets you click on a neutral object to achieve white balance
  - In “Levels” in Photoshop
  - In “basic” in Lightroom
  - In Adjustments in Aperture
- You also often have presets such as daylight, tungsten
Party name tags

• Provide excellent white references!
Challenge: mixed lighting

• In particular, flash+ambient
• Solution: put yellowish gel on the flash
• Solution 2:
  http://people.csail.mit.edu/ehsu/work/sig08lme/
Ultimate white balance solution

• But note that white balance affects the tones you get
Recap

• Follow rules or really break them
• Simplify, avoid cluttered background
  – move your viewpoint, frame tighter, shallow depth of field, desaturate
• Don’t center things
  – rule of the third, leave space for gaze or motion
• Avoid harsh light
  – golden hours, overcast days, avoid direct sunlight, go in the shade, fill flash, bounce flash, post-processing
• White balance
Portraits
Portraits: It’s all about the eyes

• Eyes should be sharp & shiny
• Be at eye level... or try unusual viewpoints
• Make sure lighting is not harsh
• Shallow depth of field can help
• Add vignetting to focus attention
• Get the white balance right (but maybe a little warm)
• Try to convert to Black and white
• Telephoto to isolate the subject (more formal)
• Wide angle to make him/her approachable and include surrounding
• Don’t hesitate to over-shoot: bits are cheap
Telephoto vs. wide angle

300mm f/2.8

24-70
Tougher than portraits: 2 people

- Focus is harder: both sets of eyes should be sharp
  – tradeoff between complex background
- Hard to get both expressions right
- => shoot like crazy
- => use photomontage

Not great (mother’s eyes are out of focus) Better
Interactive Digital Photomontage

- Aseem Agarwala et al.
- Merge multiple images
- User puts strokes to select which image where
- Graph cut + Poisson reconstruction

**Figure 1** From a set of five source images (of which four are shown on the left), we quickly create a composite family portrait in which everyone is smiling and looking at the camera (right). We simply flip through the stack and coarsely draw strokes using the *designated source* image objective over the people we wish to add to the composite. The user-applied strokes and computed regions are color-coded by the borders of the source images on the left (middle).
Landscape
Landscape / architecture

• Get a foreground element
  – rock, tree, flower
• Rule of the thirds, diagonals
  – in particular for the horizon
• Don’t hesitate to zoom in
• Manage dynamic range
  – sky is always too bright
  – graduated neutral density, HDR
  – golden hours or right after sunset
• Use a polarizer
  – darkens the sky, make colors stand out
• Alignments
  – Keep horizon straight
  – For architecture, correct verticals
• Don’t be deterred by stormy weather
• Slow shutter speed for water
Foreground helps
More interesting (foreground)
Parallels: do or don’t
Ansel Adams

- Note foreground trees in lower right
- Sky has been darkened