Camera Principles

Part I

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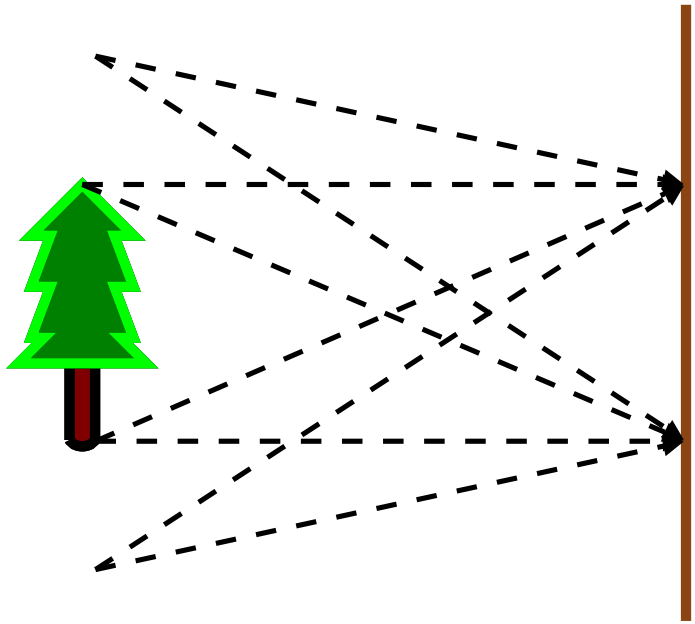
PHOTOGRAPHY

Goal: record an image onto a recording medium

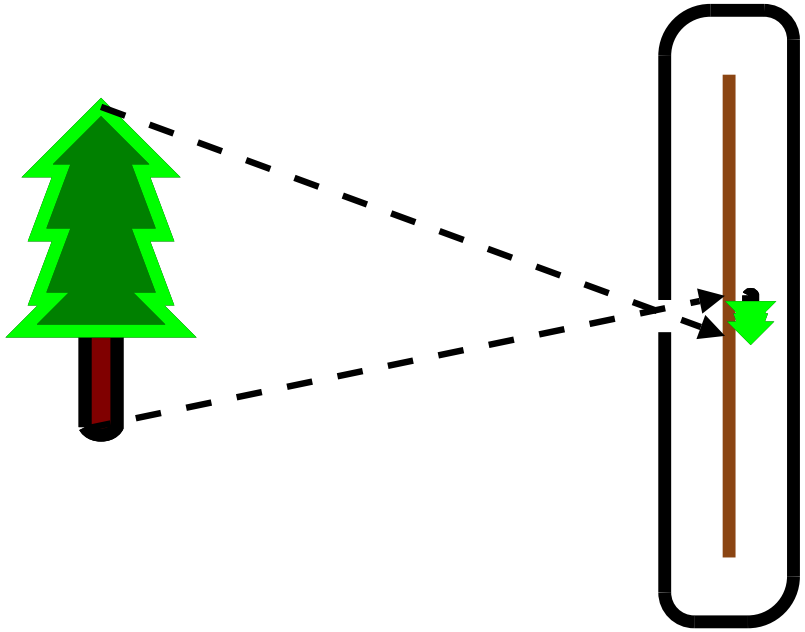
First attempt:



Problem: light from everywhere arrives at every point

Solution: put film in an enclosed box with only one entrance (*camera obscura*: dark chamber, or *camera* for short)

The Pinhole Camera

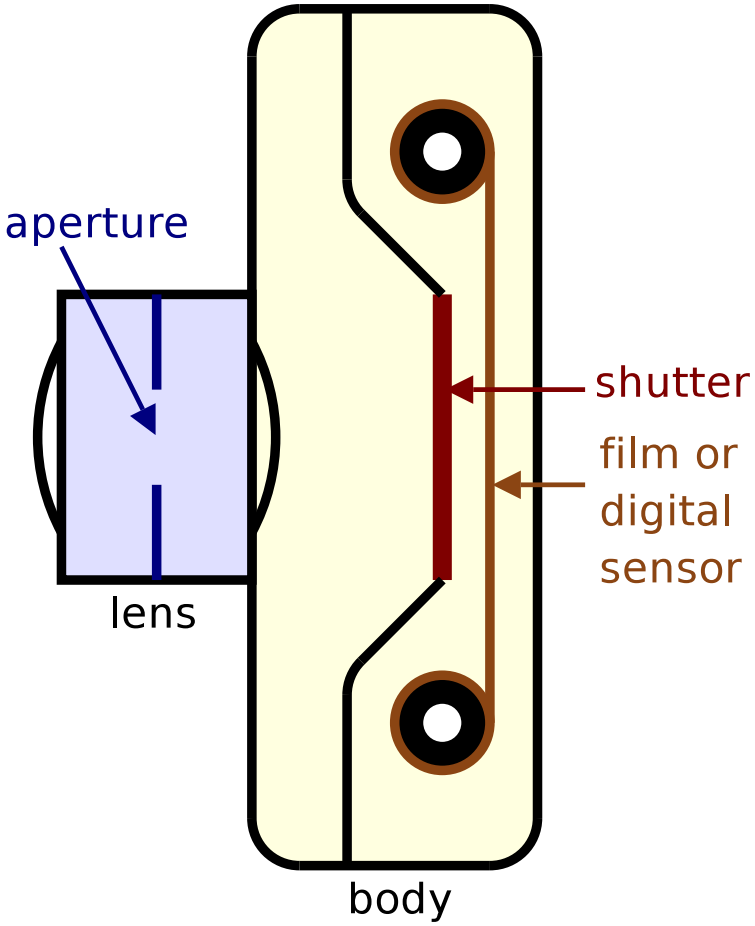


Problems:

- ➜ Long exposure necessary
  (not much light passes through pinhole)
- ➜ Poor quality due to diffraction effects

Solution: the lens, which collects light from a larger area

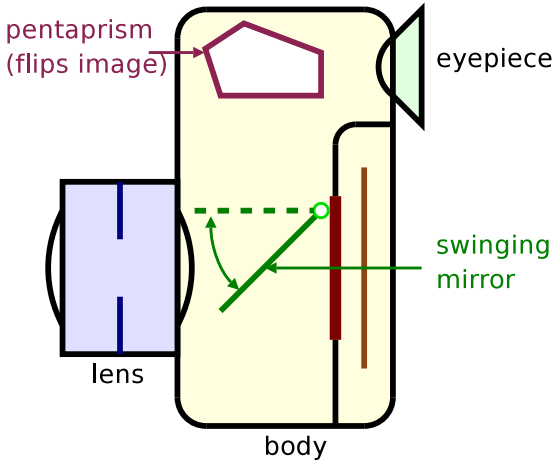
The Modern Camera



ASIDE

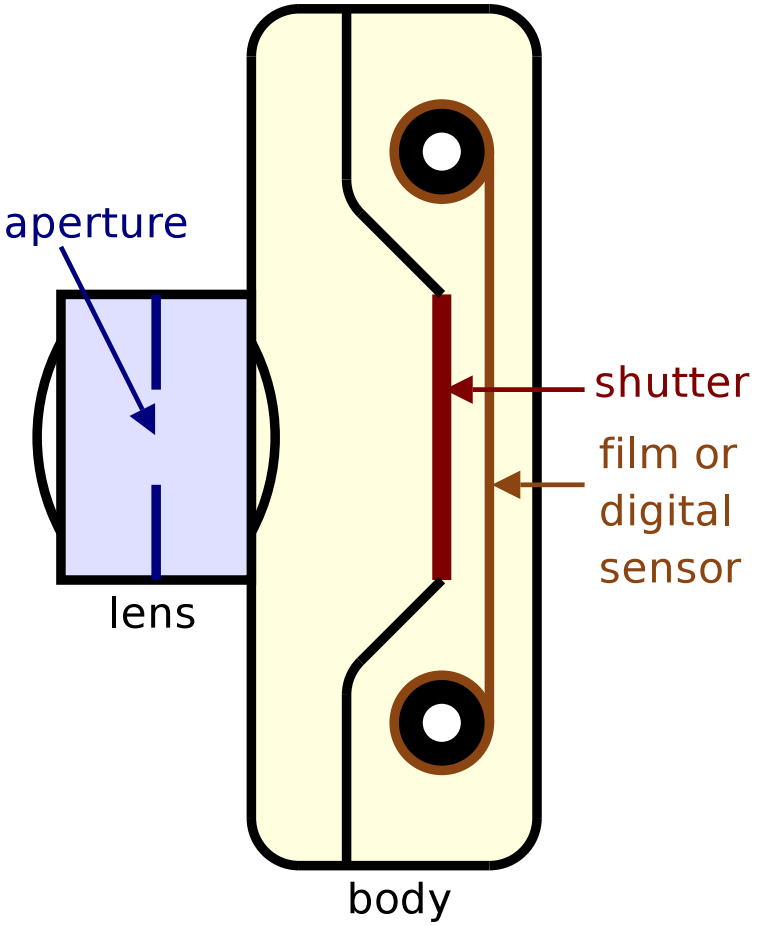
How can the photographer tell what the camera sees?

- ➜ Twin-lens cameras (includes most compact cameras)
  Photographer looks through a second lens, which approximates the camera's field of view
- ➜ Single-lens reflex (SLR) cameras
  Magic with mirrors!



- ➜ Electronic viewfinder (EVF)/Live preview
  Digital sensor constantly takes preview pictures

Basic Camera Settings



- Focal length
- Focus distance
- ISO speed (sensitivity)
- Shutter speed
- Aperture

FOCAL LENGTH

Focal length: Controls field of view ("zoom" to a layperson)

In terms of 35mm film:

- ➜ Around 50mm focal length is called normal (similar to field of view of eye)
- ➜ Shorter focal lengths are called wide angle
- ➜ Longer focal lengths are called telephoto

Actual numbers may be different for other cameras, but it is common to refer to 35mm equivalent focal length.

Prime lenses have a fixed focal length (e.g. 50mm)
Zoom lenses can be set to a range of focal lengths (e.g. 16-35mm, 80-200mm). Some consumer cameras specify a multiplication factor instead (e.g. 4x zoom).

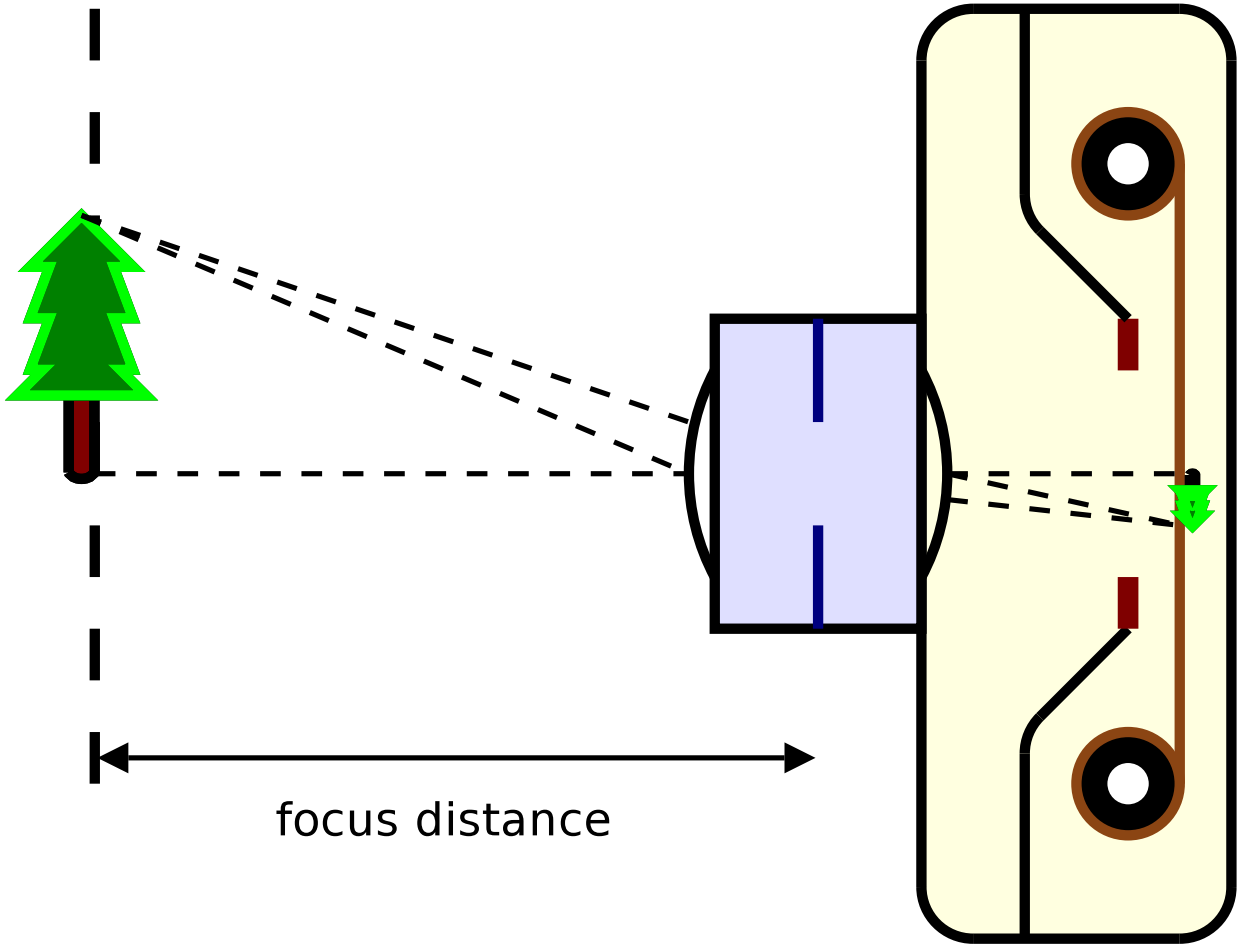
FOCAL LENGTH

Also affects perspective!

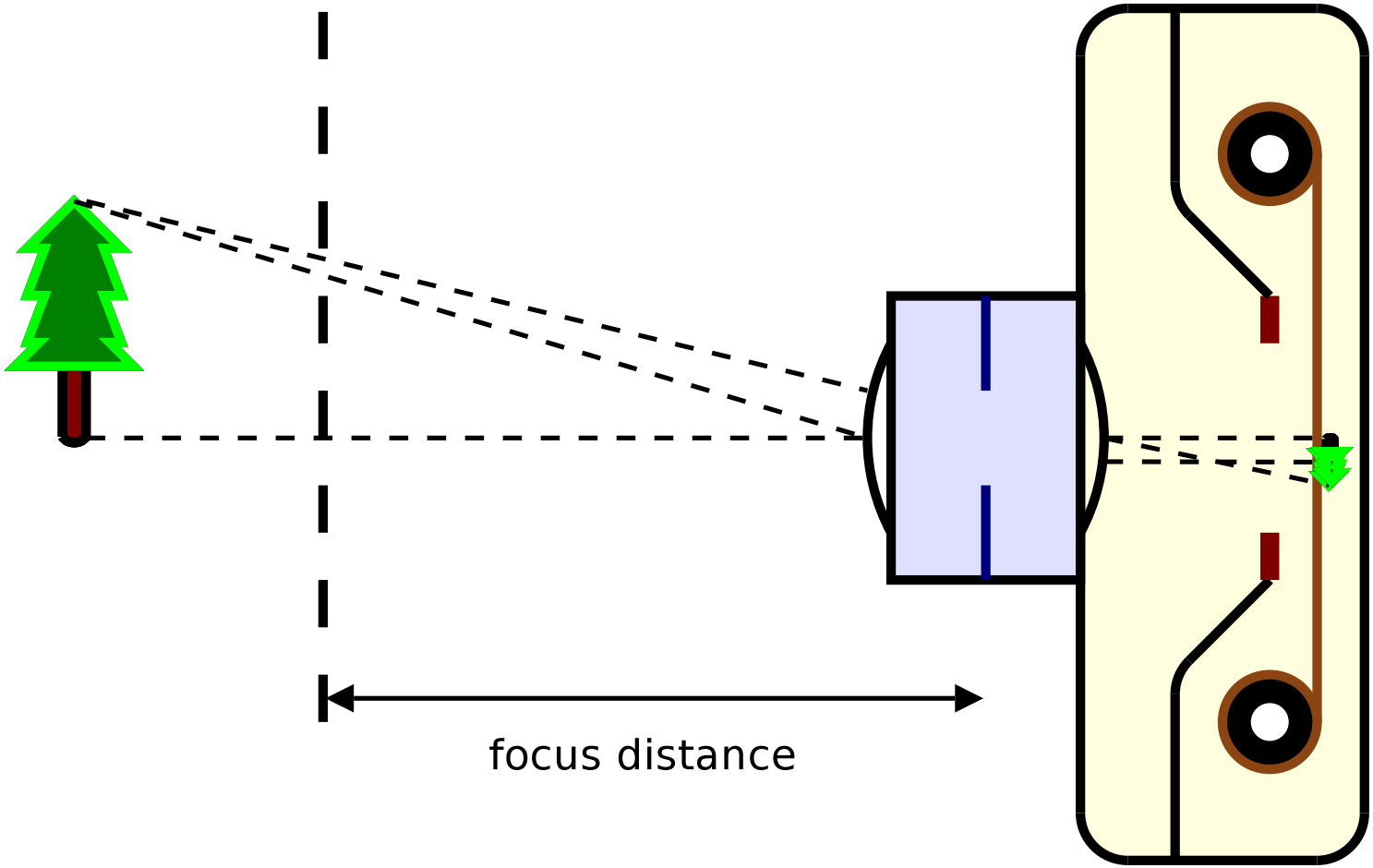
telephoto (300mm)

wide angle (28mm)

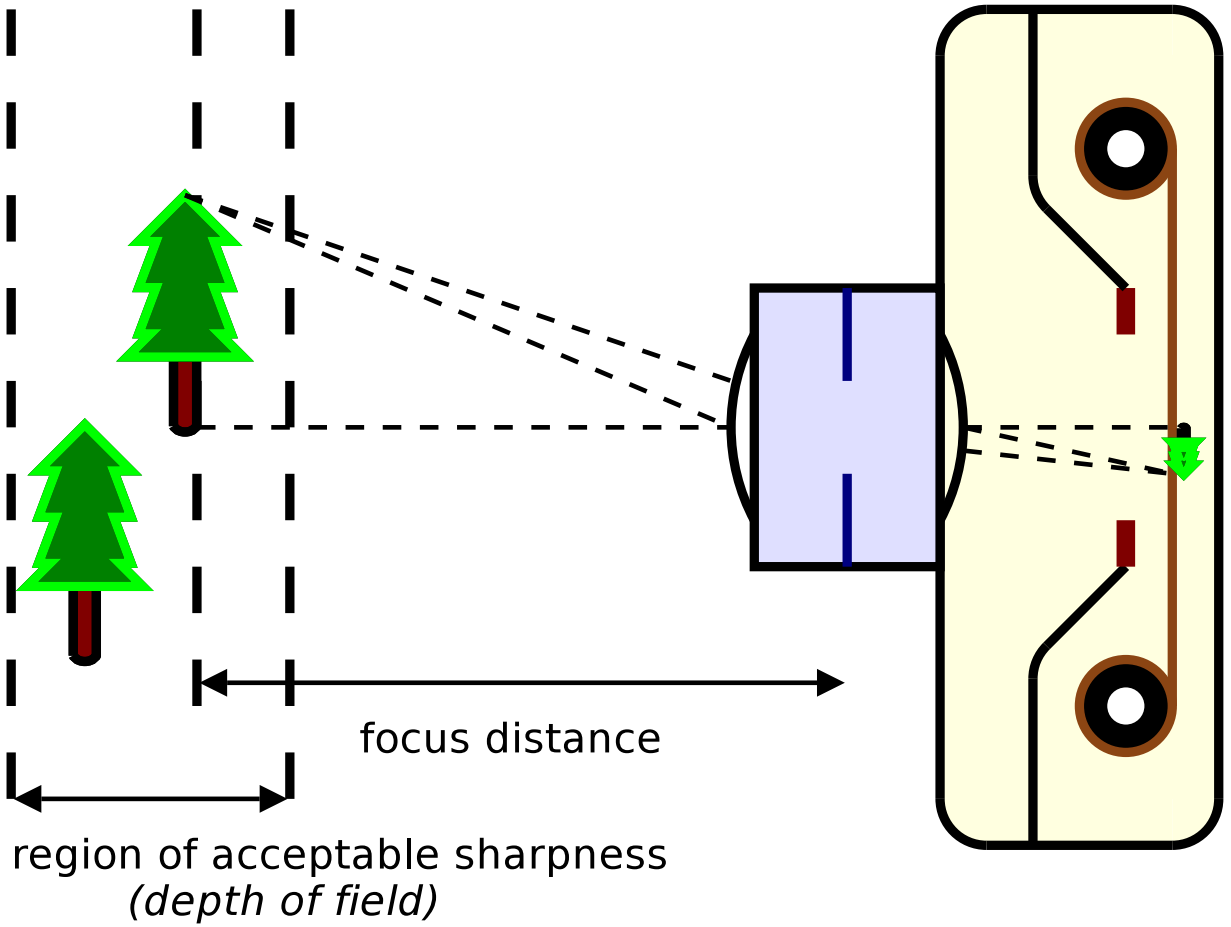
Focus Distance



Out of Focus



Depth of Field



ISO Speed (Sensitivity)

ISO Speed: Sensitivity of recording medium

- ➜ Film: Property of the film used
- ➜ Digital: Camera setting (gain of digital sensor)

Darker environments and fast motion may require higher ISO speeds, at the expense of more noise/grain.

SHUTTER SPEED

Shutter speed: Amount of time shutter is open

Beware of camera shake when handholding!

Rule of thumb (1/f rule):

When handholding the camera, at a focal length of N mm, use shutter speed of at least 1/N s.

e.g. for 50mm lens, use at least 1/50s.

Shutter Speed

Can be used for creative control

1/50s

1.3s

APERTURE

Aperture: Diameter of light-admitting hole in lens

Usually described as a ratio of focal length (e.g. f/4)

Smaller number means larger aperture!!!

Stops: **1**, **1.4** ($\sqrt{2}$), **2** ($\sqrt{4}$), **2.8** ($\sqrt{8}$), **4** ($\sqrt{16}$), **5.6** ($\sqrt{32}$), **8** ($\sqrt{64}$), **11** ($\sqrt{128}$), **16** ($\sqrt{256}$), **22** ($\sqrt{512}$), **32** ($\sqrt{1024}$)

Maximum aperture determined by lens.

Each stop halves the amount of light.

Most cameras allow setting in half-stop or one-third-stop increments.

Aperture

Affects depth of field

f/2.8 (large aperture)

f/8 (smaller aperture)

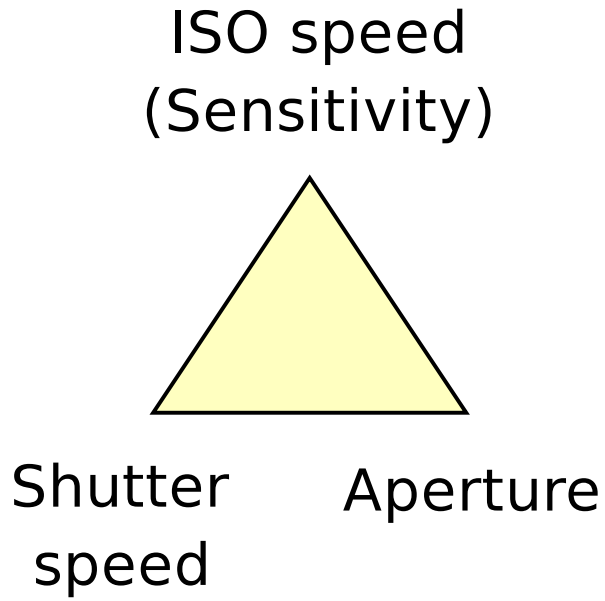
OTHER FACTORS AFFECTING DEPTH OF FIELD

- Focal length (at given subject distance)
  Longer focal length reduces DoF
- Subject distance (at given focal length)
  Closer subject distance reduces DoF
- Size of output image
  Larger print reduces DoF

The Exposure Triangle

- Shutter speed and aperture both affect the amount of light reaching the recording medium.
- ISO speed affects the sensitivity of the recording medium.

These settings need to be balanced to create the right exposure!



UNDEREXPOSURE

OVEREXPOSURE

EXPOSURE EXAMPLES

ISO100 f/2.8 1/160s

ISO100 f/8 1/20s

EXPOSURE EXAMPLES

ISO100 f/22 1.3s

ISO400 f/5.6 1/50s

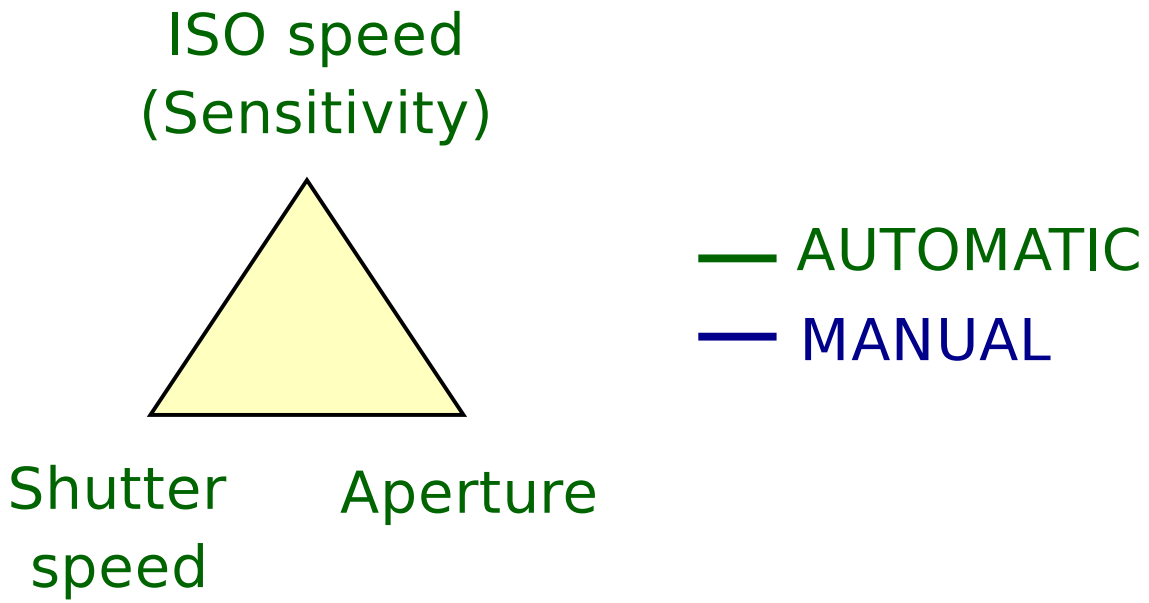
METERING

Luckily, modern cameras have built-in metering to help you

- ➜ Measures the amount of light reaching the camera
- ➜ Camera can guess some or all exposure settings
- ➜ More detailed information in Part II !

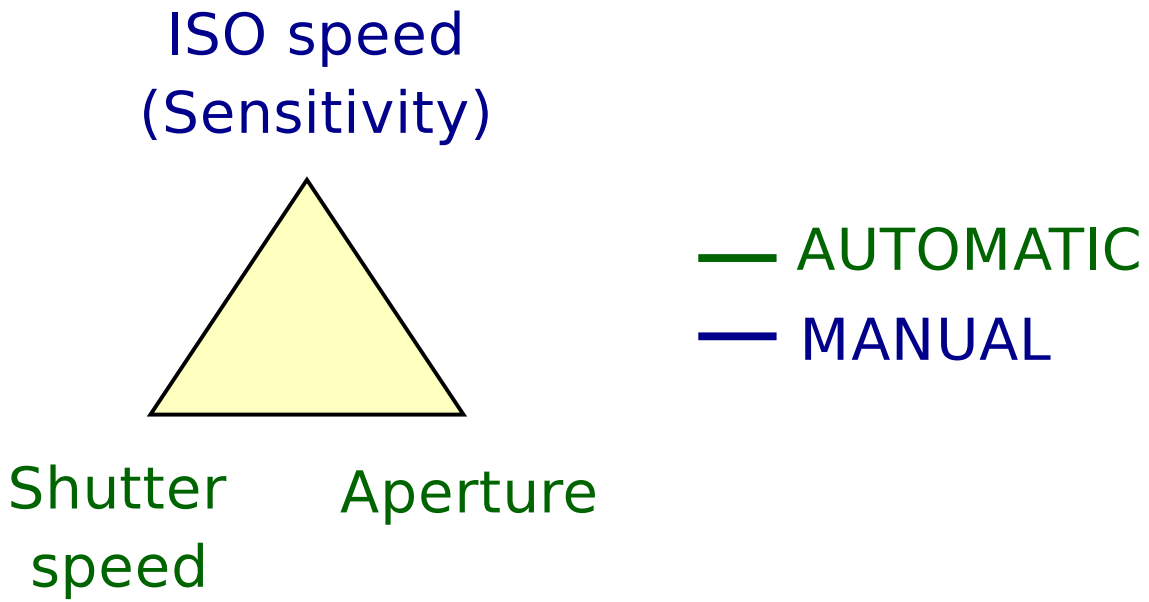
FULLY AUTOMATIC (□) MODE

All three parameters (and more) are chosen automatically.



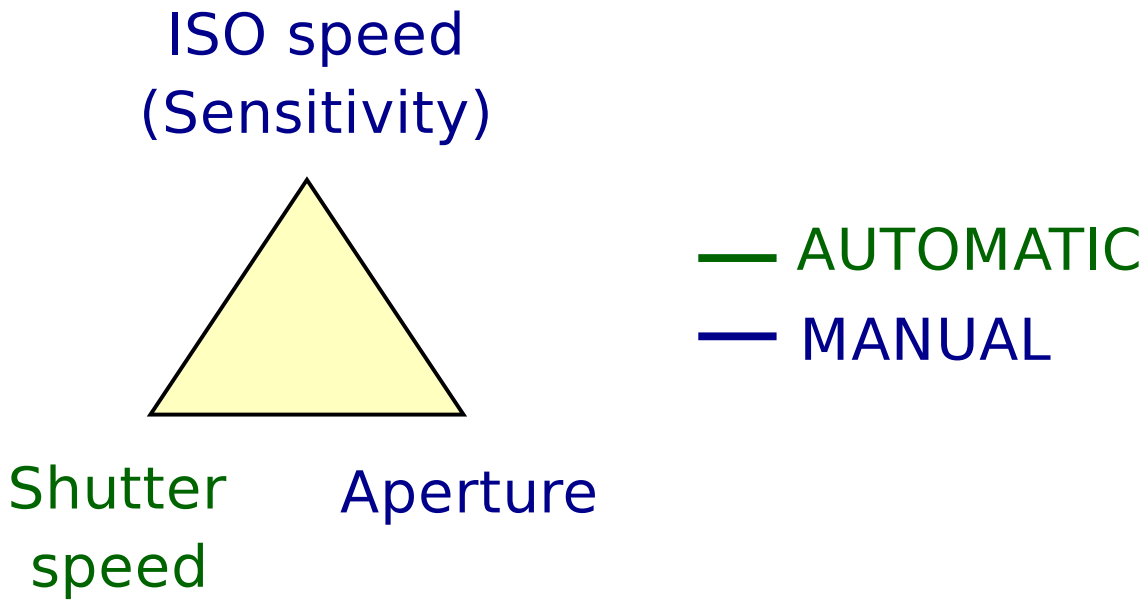
PROGRAM (P) MODE

The camera chooses the shutter speed and aperture.



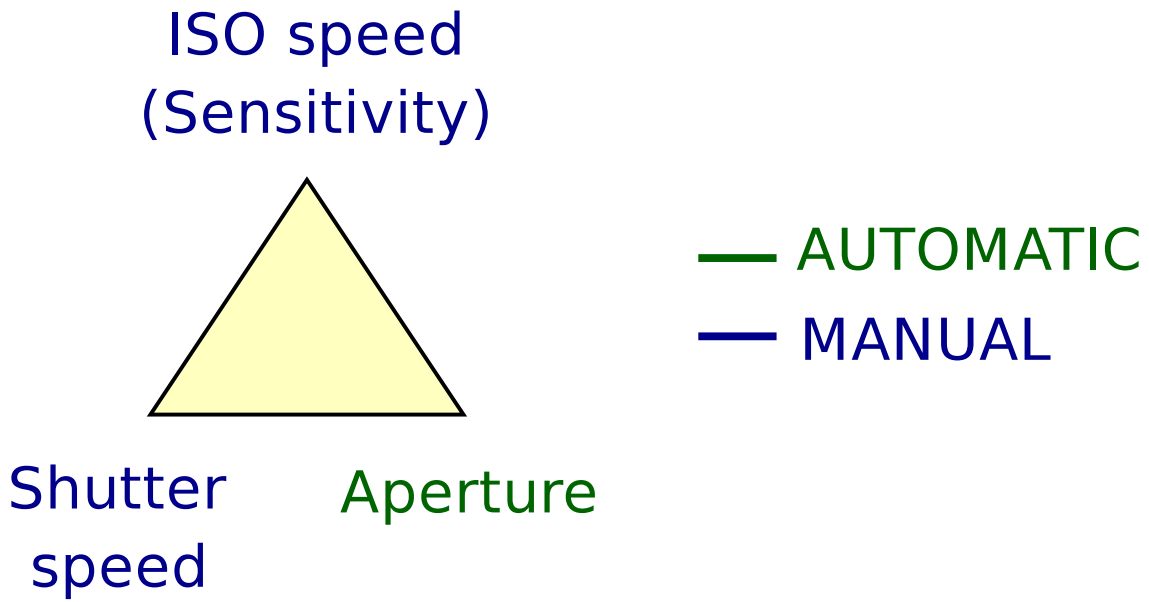
APERTURE-PRIORITY (AV) MODE

You choose aperture, the camera chooses shutter speed.



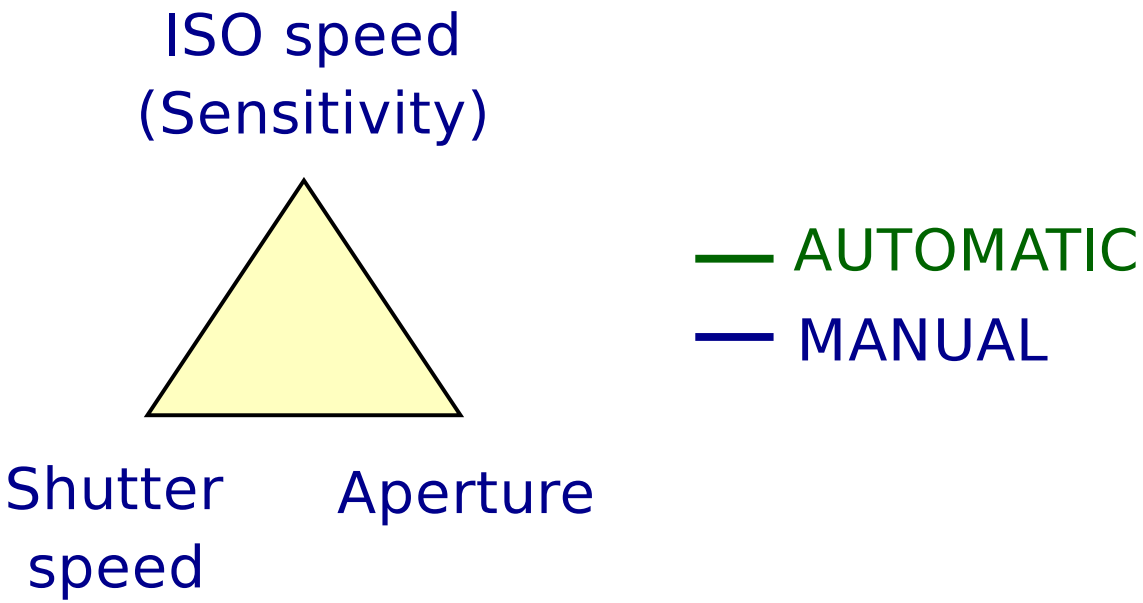
SHUTTER-PRIORITY (TV) MODE

You choose the shutter speed, the camera chooses aperture.



Manual (M) Mode

Parameters manually set. Camera just gives you an opinion.



Review

Exposure parameters

- ISO speed
- Shutter speed
- Aperture

Choose shooting mode depending on which of these parameters you want manual control over.

Other parameters discussed

- Focal length
- Focus distance

QUESTIONS