Task 2: Camera Sensor and Digital Image

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Q1: What is a good image sensor? Why are the high-end DSLR cameras expensive?

Typically, the bigger the size of the image sensor, the better. With increase in size, the number of pixels, or the size of each pixel, or both can increase. This would increase the resolution of the image as well as the light intensity sensitivity.

Sensor size increase --> signal-to-noise ratio and the dynamic range of the image sensor increase.

DSLR camera is expensive because the **image sensor size is bigger**, and better components (ie. better camera body quality, better processing chip, better materials/quality)

Q2: What is the difference between optical and digital zooms?

Optical zoom can be achieved by physically adjusting the focal length from the image sensor or changing the lens (DSLR cameras) to a lens with greater/lesser magnification. Digital zoom can be achieved by cropping the area of interest and enlarging the image via interpolation.

So, optical zoom involves a physical change to the information the image sensor receives, and digital zoom involves manipulating the already obtained image signal.

Q3: Shutter Speed (Exposure Time)

Metadata	Image 1	Image 2	Image 2
Image			
Make	Samsung	Samsung	Samsung
Model	SM-N920W8	SM-N920W8	SM-N920W8
Data and time	2019:02:07 12:38:45	2019:02:07 12:38:49	2019:02:07 12:38:55
Image file type	JPEG	JPEG	JPEG
Resolution	5312 x 2988	5312 x 2988	5312 x 2988
Focal length	4.3 mm	4.3 mm	4.3 mm
Exposure	**1/125**	**1/60**	**1/30**
ISO	125	125	125
F-number	1.9	1.9	1.9
GPS	43.470833, 80.540278	47.470833, 80.540278	47.470833, 80.540278
Flash	No Flash	No Flash	No Flash

Shutter speed determines how long the sensor is exposed to light during sensing. So, the longer the exposure time, the sensor becomes more saturated and thus the resulting image is brighter.

A longer shutter time will result in a blurry image if we try to capture moving objects. But it is good for capturing still scenes in low light settings.

A shorter shutter time is better suited to capturing scenes with moving objects.

Q4: Aperture

***Used instructor's images since Samsung's SM-N920W8 (Note 5) does not have options to change the aperture.**

Metadata	Image 1	Image 2
Image		
Make	Canon	Canon
Model	Canon EOS Rebel T6	Canon EOS Rebel T6
Data and time	2019:02:04 11:51:01	2019:02:04 11:51:16
Image file type	JPEG	JPEG
Resolution	5184 X 3456	5184 X 3456
Focal length	55.0 mm	55.0 mm
Exposure	1/160	1/160
ISO	800	800
F-number	**36**	**5.6**
GPS	N/A	N/A
Flash	On, Fired	On, Fired

Aperture controls the size of the camera opening through which the light enters.

Increasing the aperture (decreasing the f-number) allows more light to reach the sensor, leading to a brighter image but the depth of field becomes narrow, leading to a blurry scene outside the depth of field as seen in image 2.

High aperture can be useful for capturing low light scenes that are at the focal point.

Decreasing the aperture (increasing the f-number) allows less light to reach the sensor, leading to a darker image but the depth of field is wider and can capture a sharper image that contains scenes at various focal points, as seen in image 1.

Low aperture can be useful for capturing scenes that require a large depth of field.

Q5: ISO

Metadata	Image 1	Image 2	Image 2
Image			
Make	Samsung	Samsung	Samsung
Model	SM-N920W8	SM-N920W8	SM-N920W8
Data and time	2019:02:07 12:36:03	2019:02:07 12:36:10	2019:02:07 12:36:13
Image file type	JPEG	JPEG	JPEG
Resolution	5312 x 2988	5312 x 2988	5312 x 2988
Focal length	4.3 mm	4.3 mm	4.3 mm
Exposure	1/125	1/125	1/125
ISO	**200**	**400**	**800**
F-number	1.9	1.9	1.9
GPS	43.470833, 80.540278	43.470833, 80.540278	43.470833, 80.540278
Flash	No Flash	No Flash	No Flash

ISO is defines the relationship between the sensor's exposure to light vs its sensitivity to light.

Thus, the higher the ISO, the brighter the image. A higher ISO can be set to capture images of fast moving objects that require a fast shutter speed.

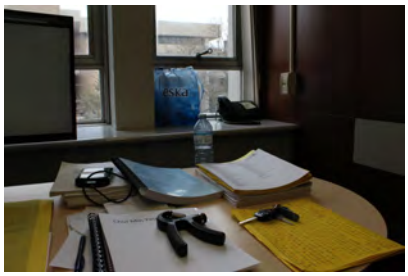
Q6: Flash

Metadata	Image 1	Image 2
Image		
Make	Samsung	Samsung
Model	SM-N920W8	SM-N920W8
Data and time	2019:02:07 12:22:13	2019:02:07 12:22:17
Image file type	JPEG	JPEG
Resolution	5312 x 2988	5312 x 2988
Focal length	4.3 mm	4.3 mm
Exposure	1/125	1/125
ISO	200	200
F-number	1.9	1.9
GPS	43.470833, 80.540278	43.470833, 80.540278
Flash	**No Flash**	**Fired**

Flash utilizes an artificial light source to brighten up the image in a low light scene. It is useful when there is not enough light to capture the scene.

Q7: Focal Length

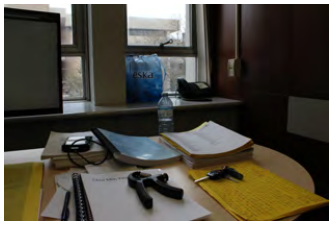
***Used instructor's images since Samsung's SM-N920W8 (Note 5) performs a digital zoom, thus the focal length does not change.**

Metadata	Image 1	Image 2
Image		
Make	Canon	Canon
Model	Canon EOS Rebel T6	Canon EOS Rebel T6
Data and time	2019:02:04 11:55:33	2019:02:04 11:55:37
Image file type	JPEG	JPEG
Resolution	5184 x 3456	5184 x 3456
Focal length	**55.0 mm**	**18.0 mm**
Exposure	1/200	1/200
ISO	1600	1600
F-number	20	20
GPS	N/A	N/A
Flash	No Flash	No Flash

The focal length for a camera with a lens is the distance between the aperture and the point where the light rays intersect. It affects how much of the scene the sensor "sees". Increasing the focal length results in a zoomed in image of the scene, while decreasing the focal length results in a zoomed out image of the scene.

Q8: Field of View

***Added field of view images based on sensor size from lecture notes (Image 3) to show effect of sensor size on field of view**

Metadata	Image 1	Image 2	Image 3
Image			
Make	Canon	Canon	N/A
Model	Canon EOS Rebel T6	Canon EOS Rebel T6	N/A
Data and time	2019:02:04 11:55:33	2019:02:04 11:55:37	N/A
Image file type	JPEG	JPEG	N/A
Resolution	5184 x 3456	5184 x 3456	N/A
Focal length	**55.0 mm**	**18.0 mm**	N/A
Exposure	1/200	1/200	N/A
ISO	1600	1600	N/A
F-number	20	20	N/A
GPS	N/A	N/A	N/A
Flash	No Flash	No Flash	N/A

Field of view is a description of the amount of observed area the image sensor "sees". It is also known as the angle of view.

The field of view is influenced by the focal length and the sensor size. As focal length increases, the field of view decreases, and vice versa. As sensor size increases, the field of view also increases. The sensor size of the coloured bounding boxes in Image 3 are in increasing sensor size as the field of view increases.