

# 全域觀天儀設計比賽

## Total Sky Imager Design Competition



<http://www.cs.hku.hk/~sky/>

Programming for Sky Images  
寫程式 · 電腦觀天

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# Programming for Sky Images

## 寫程式 · 電腦觀天

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Automating some steps  
自動進行某些步驟

# What to do in the competition? 比賽做甚麼？

- ◆ Familiarise yourselves with the requirements!  
<https://i.cs.hku.hk/~sky/Competition-English.php>  
熟讀比賽規則及作品要求！  
<https://i.cs.hku.hk/~sky/Competition-Chinese.php>
- ◆ Design and implement a total sky imager.  
設計及製作全域觀天儀。



Image source: Hong Kong Observatory



Image source: EKO ASI-16 Operator Manual



# What to do in the competition?

## 比賽做甚麼？

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- ◆ Write report.  
寫文字報告。
- ◆ (Primary School teams) Make time-lapse video.  
(小學組) 全域影像縮時影片。
- ◆ (Secondary School teams) Store the images and analyse them for cloud cover in Okta.  
(中學組) 儲存相片及分析雲量份數。
- ◆ Take Photos of the total sky imager.  
拍攝全域觀天儀的作品相片。
- ◆ Make and do presentation.  
製作及進行簡報。

# Is a computer a must? 一定要用電腦嗎？

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◆ Yes!  
是！

◆ Your mobile phone is a computer!  
Your digital camera is a computer!  
你的手提電話是一部電腦！  
你的數碼相機也是一部電腦！

# Is a general-purpose computer a must? 一定要用通用電腦嗎？

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- ◆ Yes!  
是！
- ◆ It automates the process of image capture, storage and analysis.  
可以用來自動拍照、儲存及分析。
- ◆ Primary School category: makes the time-lapse video.  
小學組：製作全域影像縮時影片。

# Is programming a must?

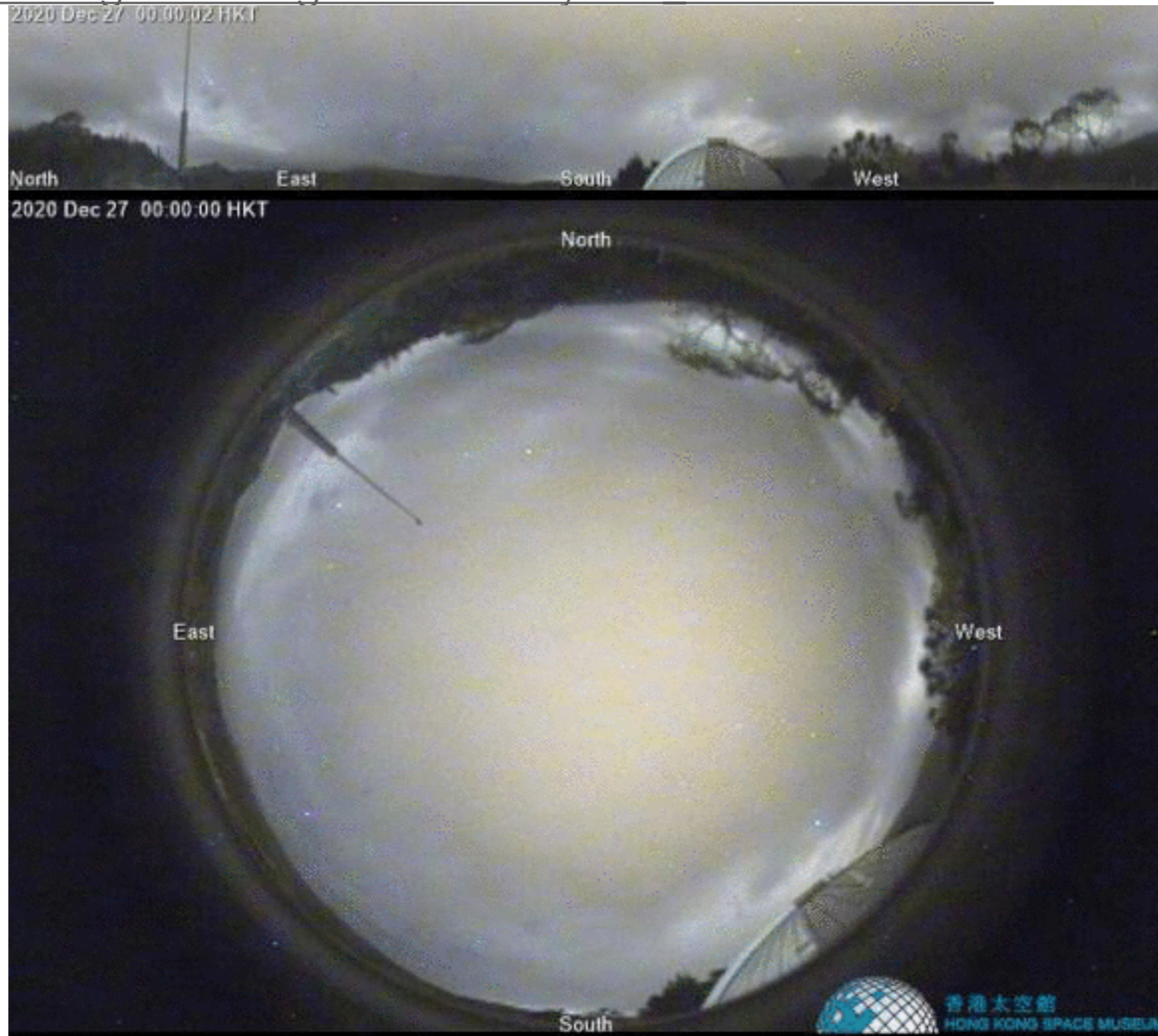
## 一定編寫程式嗎？

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- ◆ Not a must, but it helps a lot.  
不一定，但會很有幫助。
- ◆ Use application programs, e.g., video editing software.  
例如利用剪片的應用程式。
- ◆ Automatic analysis for cloud cover reading requires programming.  
要自動分析相片找出雲量份數，就要寫程式了。

# Animation of the latest all sky images 最新全天影像動畫

- ◆ [https://www.hko.gov.hk/en/gts/astronomy/site\\_one.htm?site=2](https://www.hko.gov.hk/en/gts/astronomy/site_one.htm?site=2)  
[https://www.hko.gov.hk/tc/gts/astronomy/site\\_one.htm?site=2](https://www.hko.gov.hk/tc/gts/astronomy/site_one.htm?site=2)





# How to get the images? 怎樣拿到那些圖片？

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- ◆ Is it related to our project?  
與我們的計劃有關嗎？
  - \* Not directly, but the techniques will be useful.  
沒有直接關係，但學到的方法會有用。
- ◆ Find out what the pictures' URLs are.  
找出原圖的URL是甚麼。
- ◆ Download from the URLs.  
從所得的URL下載。
- ◆ Let's try to automate the process of downloading the images.  
我們嘗試自動下載那些圖吧。

# Writing shell scripts

## 寫shell script

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- ◆ One way to automate is to write shell scripts.  
寫shell script是自動化的方法之一。
- ◆ A shell is a command line interface (CLI) for doing things.  
Shell是命令行界面執行指令的環境。
- ◆ The shell provides a programming environment. Constructs like loops and conditionals are available.  
Shell提供了編程環境，可使用如迴圈和條件式語句。
- ◆ The command line or terminal environment is the shell environment.  
指令行或終端機環境就是shell環境。

# Writing shell scripts

## 寫shell script

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- ◆ `bash` is used as the shell in the following examples.  
以下例子用`bash`這個shell.
- ◆ `bash` stands for Bourne-Again SHell, and is one of the most popular shells.  
`bash` Bourne-Again SHell, 是最流行的shell之一。

# bash on Windows

## 在Windows裏用bash

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- ◆ bash can be used in Windows as well.  
Windows 也可用 bash.
- ◆ Search for "Windows Features" in search box, then enable "Windows Subsystem for Linux". Restart after installation.  
搜尋 "Windows Features" 然後揀選 "Windows Subsystem for Linux". 安裝後要重新啟動Windows.
- ◆ bash can be run afterwards. Search for "bash" in search box.  
之後便可執行bash. 搜尋bash找它出來。
- ◆ You can also install a Linux distribution, e.g., Ubuntu 20.04 LTS.  
你亦可安裝 Linux distribution, 例如 Ubuntu 20.04 LTS.
- ◆ <https://docs.microsoft.com/en-us/learn/modules/get-started-with-windows-subsystem-for-linux/>

# Download file from URL

## 從URL下載檔案

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- ◆ Assume the URL is  
就當URL是

`https://www.hko.gov.hk/gts/astronomy/image/hksm/asc_hksm_h16m00.jpg`

- ◆ The file can be downloaded using the tool `curl`.  
利用軟件工具`curl`就可以下載檔案。

- ◆ The command is:  
指令是：

`curl -O https://www.hko.gov.hk/gts/astronomy/image/hksm/asc_hksm_h16m00.jpg`

# Download file from URL

## 從URL下載檔案

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- ◆ We have been dealing with the URL  
我們在處理的URL是  
`https://www.hko.gov.hk/gts/astronomy/image/hksm/asc\_hksm\_h16m00.jpg`
- ◆ Did you notice that this file is that for the 4pm image?  
留意到這URL是下午四時的相片嗎？
- ◆ What's the URL for the next image? The one after next?  
下一張相片的URL是甚麼？再下一張呢？
- ◆ What's the picture-taking interval?  
拍照相隔多久？
- ◆ What do you think the URLs for other times are?  
你認為其他時間的URL是甚麼呢？

# Download file from URL

## 從URL下載檔案

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- ◆ Let's try downloading using CLI

我們用指令行下載檔案吧

- ◆ 

```
curl -O https://www.hko.gov.hk/gts/astronomy/image/hksm/asc_hksm_h16m00.jpg
curl -O https://www.hko.gov.hk/gts/astronomy/image/hksm/asc_hksm_h16m05.jpg
curl -O https://www.hko.gov.hk/gts/astronomy/image/hksm/asc_hksm_h16m10.jpg
curl -O https://www.hko.gov.hk/gts/astronomy/image/hksm/asc_hksm_h16m15.jpg
curl -O https://www.hko.gov.hk/gts/astronomy/image/hksm/asc_hksm_h16m20.jpg
curl -O https://www.hko.gov.hk/gts/astronomy/image/hksm/asc_hksm_h16m25.jpg
curl -O https://www.hko.gov.hk/gts/astronomy/image/hksm/asc_hksm_h16m30.jpg
curl -O https://www.hko.gov.hk/gts/astronomy/image/hksm/asc_hksm_h16m35.jpg
curl -O https://www.hko.gov.hk/gts/astronomy/image/hksm/asc_hksm_h16m40.jpg
curl -O https://www.hko.gov.hk/gts/astronomy/image/hksm/asc_hksm_h16m45.jpg
curl -O https://www.hko.gov.hk/gts/astronomy/image/hksm/asc_hksm_h16m50.jpg
curl -O https://www.hko.gov.hk/gts/astronomy/image/hksm/asc_hksm_h16m55.jpg
```

- ◆ That looks cumbersome. Only the minute entry changes, use loop.  
看來很煩啊。只是分鐘數變，用迴圈吧。

# Download file from URL

## 從URL下載檔案

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- ◆ Let's write a loop to print 00, 05, 10,..., 55 first.

我們先寫個迴圈印00, 05, 10,..., 55出來吧。

- ◆ 

```
for ((m=0; $m<60; m=$(( $m+5)) ))
do
    echo $m
done
```

- ◆ Oh, it printed 0 and 5 not 00 and 05. This needs to be done.

這樣，印了0和5而不是00和05. 要這樣才行。

- ◆ 

```
for ((m=0; $m<60; m=$(( $m+5)) ))
do
    echo $(printf "%02d" $m)
done
```

- ◆ Now we can write the loop to do the downloading.

現在可以寫下載照片的迴圈了。



# Download file from URL

## 從URL下載檔案

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- ◆ Integrating what we have tried.  
整合我們試過的東西。

- ◆ 

```
for ((m=0; $m<60; m=$((m+5)) ))
do
    mm=$((printf %02d $m))
    echo "16 $mm"
    curl -O "https://www.hko.gov.hk/gts/astronomy/image/hksm/asc_hksm_h16m${mm}.jpg"
done
```

- ◆ This script can be saved into a file and make it executable like a program.  
這個script可以儲存成檔案，然後使它像普通應用程式一樣，可以直接運行。

# Download file from URL

## 從URL下載檔案

---

### ◆ Program code 程式碼：

```
◆ #!/bin/bash  
  
for ((m=0; $m<60; m=$((m+5)) ))  
do  
    mm=$(printf %02d $m)  
    echo "16 $mm"  
    curl -O "https://www.hko.gov.hk/gts/astromony/image/hksm/asc_hksm_h16m${mm}.jpg"  
done
```

To tell the operating system that this script is to be run by bash.

告訴作業系統這script用bash運行。

◆ Save it into the file `get_hksm_16.sh`  
儲存至 `get_hksm_16.sh` 檔案。

◆ Change it to be executable in the shell:  
在shell內使這檔案可執行：  
`chmod +x get_hksm_16.sh`

# Challenge

## 挑戰

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- ◆ Challenge: how to get the images for the other hours?  
挑戰：如何下載其他鐘數的相片？
- ◆ Other locations?  
其他地點呢？

# 製作Animated GIF

## Making an Animated GIF

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- ◆ ImageMagick is the tool set for image manipulation in command line interface (CLI) and scripts.

用命令行界面和寫script處理圖像可用ImageMagick.

<https://imagemagick.org/>

- ◆ Example of making animated GIF:

製作Animated GIF的例子：

```
magick -delay 100 a.jpg b.jpg -delay 20 a.jpg b.jpg m.gif
```

# Programmable applications for image analysis

## 可編程做影像分析的應用程式

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- ◆ ImageMagick

<http://imagemagick.org/>



- ◆ GIMP: GNU Image Manipulation Program

<https://www.gimp.org/>



- ◆ Blender

<https://www.blender.org/>



# Programming environment for image analysis

## 分析影像的編程環境

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- ◆ Processing

<https://processing.org/>



- ◆ Python

<https://www.python.org/>



- \* Anaconda Individual Edition

<https://www.anaconda.com/products/individual>



Individual Edition

- ◆ We'll use Anaconda Individual Edition in an upcoming talk to outline the procedures for data processing and visualisation. 我們將在未來的講座用Anaconda Individual Edition談數據處理及可視化的方法。

# Question-and-answer time

## 問答時間

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