## Matlab Solve TSP with Parallel and Distributed Computing

107.07.09 Vicky Kuo • TSP 問題是什麼呢?

一個推銷員打算行走2000個城市,他應該怎麼走才可以用最 短的距離經過每個地方呢?

想像一下~~~

用最短的距離把2000個點連起來



• TSP for 2000 cities



• 什麼是平行分散運算(Parallel and Distributed Computing)



New to MATLAB? See resources for Getting Started.

#### • 營造適合做運算的環境

• MATLAB 要有 MDCE 的工具箱

(( MDCE = Matlab Distributed Computing Engine)

- 設定環境
  - 1. 設定路徑C:\Program Files\MATLAB\R2017a\toolbox\distcomp\bin
  - 打開MATLAB,在Command Window 輸入 !mdce install 安裝mdce
     (若已安裝 要先輸入 !mdce uninstall 解除mdce 再重新安裝)
  - 3. 在Command Window 輸入 !mdce start 啟動mdce
  - 4. 關閉防火牆
  - 5. 在Admin Center作業,把所有電腦連接起來
    - ① 到C:\Program Files\MATLAB\R2017a\toolbox\distcomp\bin
    - ② 在admincenter 點選右鍵進入作設定

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#### • 營造適合做運算的環境

• 在選為 Host 的電腦輸入所有欲連結的電腦 IP 位置

((可以到 cmd 輸入 ipconfig/all 查詢當台電腦的 IP)

• 在其他台電腦輸入當台的 IP 與 作為 Host 的電腦 IP

📣 Admin Center						_	$\Box \times$
File Hosts MJS	Workers Help						
Hosts							0
<u>Add cr Fird</u>		Host		MD	CE Service	MJS	Work
Start indice Service	Hostname	<ul> <li>Reachable</li> </ul>	Cores	Status	Up Since	Name	Count
Stop mdce Service	am5-1. (192.168.1.214)	yes	4	running	2018-07-06 16:53		4
Test Connectivity	am5-3. (192.168.1.211)	ves	4	running	2018-07-06 16:52		4
	am5-4 (192 168 1 181)	yes	4	running	2018-07-06 16:51		4
	am5-5. (192.168.1.166)	yes	4	👂 running	2018-07-06 16.35	TSP4000	4
	am5-6. (192.168.1.240)	yes	4	running	2018-07-06 16:33		4
	am5-7. (192.168.1.217)	yes	4	running	2018-07-06 16:32		4
	am5-8. (192.168.1.197)	yes	4	👂 running	2018-07-06 16:31		4
				<u>.</u>			

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#### • 營造適合做運算的環境

• 在選定的 Host 電腦上建立成一個 Job

	Ver			
lew N	/IATLAB Job Schedule	er (MJS)		×
Ent	er a name for this MJ	S: TSP		
Но	st to start this MJS on	: am5-	5. (192.168. <mark>1</mark> .166)	~
A	dmin user			
	MATLAR Distributed (	Computi	na Server on host	
	192.168.1.166 is runni Therefore, no admin i required.	ing secur user exist	rity level 0. ts and no password	d is
	192.168.1.166 is runni Therefore, no admin i required. Password of admin us	ing secur user exist	rity level 0. ts and no password	d is

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#### • 營造適合做運算的環境

- 啟動已經建立好的 Job
- 要注意每台電腦選取的核心數量要一致

	Hostname 🔺	Cores	Existing Work	
	am5-1. (192.168.1.214)	4	4	
05500 0000 0	am5-2. (192.168.1.184)	4	4	
Select All	am5-3. (192.168.1.211)	4	4	
	am5-4. (192.168.1.181)	4	4	
Clear All	am5-5. (192.168.1.166)	4	4	~
IATEAD JOD Scheduler (MIS)				
Select the MJS for the new wo	orkers. TSP@am5-5.			~
Select the MJS for the new wo	orkers. TSP@am5-5.			~
Select the MJS for the new wo /orkers Specify how many workers to	orkers. TSP@am5-5. start.	Start	4 <b>€</b> workers per	~ host

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#### • 營造適合做運算的環境

📣 Admin Center

• 在選為 Host 的電腦輸入所有欲連結的電腦 IP 位置

((可以到 cmd 輸入 ipconfig/all 查詢當台電腦的 IP)

• 在其他台電腦輸入當台的 IP 與 作為 Host 的電腦 IP

<u>id er Find </u>	H	lost		MD	CE Service	MJS	Work
indce Service	Hostname	^ Reachable	Cores	Status	Up Since	Name	Count
Contine	am5-1. (192.168.1.214)	yes	4	running	2018-07-06 16:53		4
6 /261/1C6	am5-2. (192.168.1.184)	yes	4	running	2018-07-06 16:53		4
ectivity	am5-3. (192.168.1.211)	yes	4	running	2018-07-06 16:52		4
	am5-4 (1921681181)	ves	4	running	2018-07-06 16:51		4
	am5-5. (192.168.1.166)	yes	4	primmi 🥑	2018-07-06 16.35	TSP4000	4
	am5-6. (192.168.1.240)	yes	4	running	2018-07-06 16:33		4
	am5-7. (192.168.1.217)	yes	4	running	2018-07-06 16:32		4
	am5-8. (192.168.1.197)	ves	4	running	2018-07-06 16:31		4

● 8 台各有 4 核心的電腦 → 一台擁有 32 核心的電腦

Stort         Name         Hostname         Status         Up Since         Worket           Slut         TSP4000         am5-5.         Image: status         2018-07-06 16:57         32	
Sluu TSP4000 am5-5. Orunning 2018-07-06 16:57 32	rs
Fegure	

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#### • 營造適合做運算的環境

• 此時每個 worker 已經全部啟動

	Worker				MIS		
Name	∧ Hostname	Status	Up Since	Connection	Name	Hostname	
am5-1worker01	am5-1.	busy	2018-07-06 17:	connected	TSP4000	am5-5.	<b>-</b> ~
am5-1work <del>e</del> r02	am5-1.	busy	2018-07-06 17:	connected	TSP4000	am5-5.	
am5-1, worker03	am5-1.	busy	2018-07-06 17:	connected	TSP4000	am5-5.	
am5 1workcr04	am5 1.	busy	2018 07 06 17:	connected	TSP4000	am5 5.	
am5-2worker01	am5-2.	busy	2018-07-06 17:	connected	TSP4000	am5-5.	
am5-2worker02	am5-2.	busy	2018-07-06 17:	connected	TSP4000	am5-5.	
am5-2worker03	am5-2.	busy	2018-07-05 17:	connected	TSP4000	am5-5.	
am5-2worker04	am5-2.	busy	2018-07-06 17:	connected	TSP4000	am5-5.	
am5-3worker01	am5-3.	busy	2018-07-06 17:	connected	TSP4000	am5-5.	
am5-3_worker02	am5-3	busy	2018-07-06 17	connected	TSP4000	am5-5	
arn5-3worker03	am5-3.	busy	2018-07-06 17	connected	TSP4000	am5-5.	
am5-3worker04	am5-3.	busy	2018-07-06 17:	connected	TSP4000	am5-5.	
am5-4worker01	am5-4.	busy	2018-07-06 17	connected	TSP4000	am5-5.	
am5-4worker02	am5-4.	busy	2018-07-06 17:	connected	TSP4000	am5-5.	
am5-4worker03	am5-4.	busy	2018-07-06 17:	connected	TSP4000	am5-5.	
am5-4. worker04	am5-4.	busy	2018-07-06 17:	connected	TSP4000	am5-5.	$\sim$
am5 5. worker01	amb b.	busy	2018/07/06/17:	connected	1SP4000	amb b.	~
am5-5worker02	am5-5.	busy	2018-07-06 17	connected	TSP4000	am5-5.	
am5_5_worker03	amb b.	busy	2018/07/06/17:	connected	TSP4000	amb b.	
am5-5worker04	am5-5.	busy	2018-07-06 17:	connected	TSP4000	am5-5.	
am5-6worker01	amb-b.	busy	2018-07-06 17:	connected	TSP4000	amb-b.	
am5-6worker02	am5-6.	busy	2018-07-06 17:	connected	TSP1000	am5-5.	
am5-6_worker03	am5-6	busy	2018-07-06 17	connected	TSP4000	am5-5	
am5-6, worker04	am5-6.	busy	2018-07-06 17:	connected	TSP4000	am5-5.	
am5-7_worker01	am5-7	busy	2018-07-0617	connected	TSP4000	am5-5	
am5 7. worker02	am5 7.	busy	2018/07/06 17:	connected	T5P4000	am5 5.	
am5-7worker03	am5-7.	busy	2018-07-06 17	connected	TSP4000	am5-5.	
am5 7. worker04	amb /.	busy	2018/07/06/17:	connected	TSP4000	amb b.	
am5-8_worker01	am5-8.	busy	2018-07-06 17	connected	TSP4000	am5-5.	
am5 8_worker02	amb 8.	busy	2018/07/06/17:	connected	TSP4000	amb b.	
am5-8_worker03	am5-8.	busy	2018-07-06 17:	connected	TSP4000	am5-5.	
am5-8_worker04	amb-8.	busy	2018-07-06 17:	connected	TSP4000	amb-5.	$\checkmark$

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#### ● 在 MATLAB 啟用 Parallel Computing

- 完成路徑設定以及連接電腦後,回到 MATLAB
- MATLAB 設定
  - 1. 點選 Parallel → Manage Cluster Profiles

HOME PLOTS	APPS								þe
New New Open 🔁 Cumpare	mport Save Data Workspace	Gear Workspace ▼	Analyze Cocle	Eayout	<ul> <li>Preferences</li> <li>Set Path</li> <li>Para let</li> </ul>	Add-Cins	2 Help	Community	
	am Files ► MATLAB	■ R2017a ► toolbox ■ Command Window	distcomp • bin •		Default Cluster Discover Cluster	s		NEGO CICES	 £
Name -		New to MATLAB? See m	esources for <u>Getting Starte</u>	<u>d</u>	Parallel Preferen Manage Cluster	ues Profiles			×
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<ul> <li>accounce ther bat</li> <li>createSharedSecret.bat</li> <li>mdce.bat</li> <li>mdce.def bat</li> </ul>		wrapper   MATLA Starting patelle. CompEctor to 16 a	II (istributed Corputi . Jool (paiglot) usin, worke-c	rg Serve g .be '∵	Cloud Center W Test Cloud Conn	eb Application	n		

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#### ● 在 MATLAB 啟用 Parallel Computing

- MATLAB 設定
  - 2. 預設狀況只有 local 所以要點選 Discover Clusters 把剛剛建立的 Job 在

Matlab 裡面啟動

📣 Cluster Frefile Man	nger.							л. с. П.	×
Ado Discovor mpon Clusters	💋 🖳 Dup icab t Edit 🗊 De ete	e 🔗 Rename 🛨 Set as Default	Export	Validate	() Holp				
Cl. ster Ph	🌢 Discover Clusters							× i (Low to con	figure)
scal (default) 1411 AB Para lef Clou SP	Select a cluster to u	lusters were found ise.						ers wizard.	
	Cluster Name	Host	Workers	т	урс	Relase	Profi c Name		
	15.F A	mh-5		32 MIS		R5017a	139		
	The selected dial an additional p	ustor alroady has pr rofile (umber of compute	rofi cis) as ational th	sociatzd w reads to uw	ith t.Clo	king on the Nex 1 (delauli)	t button will create Vext Cancel		
	e N	ach worker urThoods							
								1	Edit

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#### 在 MATLAB 啟用 Parallel Computing

- MATLAB 設定
  - 3. 啟動後要對此 Job 做驗證



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#### • 在 MATLAB 啟用 Parallel Computing

• 在預設狀況下 Parallel Pool 是 12,這會導致即便連接 32 核心也只能啟動 12 核

心,因此我們需要來到 Preferences → Parallel Computing Toolbox 調整上限的設

Image: Set Path       Image: Set Path         Image: Default Cluster       Command Hitory         Command Hitory       Command Hitory         Solver Comparison       Command Hitory         Command Hitory       Command Hitory         Solver Comparison       Command Hitory         Command Hitory	定 🖉		Lavout //dc-ons neio		
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	定 Preferences Set Path Parallel Default Cluster 2.	<ul> <li>Preferences</li> <li>MATLAB <ul> <li>Add Ons</li> <li>App Designer</li> <li>Code Analyzer</li> <li>Colors</li> <li>Command History</li> <li>Command Window</li> <li>Comparison</li> <li>Current Folder</li> <li>Editor/Debugger</li> <li>Figure Copy Template</li> <li>Fonts</li> <li>General</li> <li>GUIDE</li> <li>Halp</li> <li>Keyboard</li> <li>Tool bars</li> <li>Variables</li> <li>Web</li> <li>Workspace</li> </ul> </li> <li>Parallel Computing Toolbox</li> </ul>	Parallel Computing Toolbox Preferences       Clusters       Default Cluster       TSP4000       Cluster profiles can be created and edited in Cluster Profile Manager       Parallel Pool       Preferred number of workers in a parallel pool; 32       Note. The actual number of workers comprising the parallel pool might be fewer, if few workers or cores are available       Automatically create a parallel pool (if one doesn't already exist) when parallel keyze parfor) are executed.       Shut down and delete a parallel pool after it is idle for:       30     minutes	ner nots (e g	×
			OK Cancel Apply	Help	

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### • 在 MATLAB 啟用 Parallel Computing

• 在 Command Window 輸入 parpool 確認先前所做的所有設定是否完成

Command Window		$\odot$
New to MATLAB? See resource	s for <u>Getting Started</u> .	×
102		^
>> parpool		
Starting parallel pool	(parpool) using the 'TSP' profile	
connected to 32 worker	δ.	
Vestore a		
ans =		
<u>Pool</u> with properties:		
Connected:	true	
NumWorkers:	32	
Cluster:	TSP	
AttachedFiles:	{}	
IdleTimeout:	30 minutes (30 minutes remaining)	
SpmdEnabled:	true	
·		
$Jx \gg$		Y

See resources for Cetting Started



# Thanks for your listening

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