

國立清華大學 103 學年第 2 學期新開課程課程大綱

科號	系神所	組別		學分	1	人數限制	
修課年級	<input checked="" type="checkbox"/> 大學部 3 年級以上 <input checked="" type="checkbox"/> 碩士班一年級以上(含博士班) <input type="checkbox"/> 碩士班二年級以上(含博士班)						
上課時間	W6			教室			
科目中文名稱	資料視覺化簡介						
科目英文名稱	Introduction of Data Visualization						
任課教師	焦傳金						
擋修科目				擋修分數			

※下列各欄由任課教師提供※

一、課程說明	有效的溝通是科學研究者的必備要件，科學數據的視覺化有助於將複雜的實驗結果轉化成簡單的圖像表徵，因此可有效的將抽象概念清楚傳達給讀者或觀眾。本課程希望藉由理論與範例的說明，讓學生瞭解如何將實驗數據以圖表方式呈現，以達到有效溝通的目的。	
二、指定用書	Data Points: Visualization That Means Something, NATHAN YAU, John Wiley & Sons: 2013	
三、參考書籍	Visual Strategies: A Practical Guide to Graphics for Scientists and Engineers, FELICE FRANKEL and ANGELA DEPACE, Yale University Press: 2012	
四、教學方式	以講述為主、課堂討論為輔	
五、教學進度	週次	授課內容
	1	Understanding dada (type and structure)
	2	Understanding dada (variability, uncertainty, and context)
	3	Visualization (analysis and exploration)
	4	Visualization (information graphics and presentation)
	5	Visualization (components)
	6	Data exploration (process)
	7	Data exploration (categorical data)
	8	Data exploration (time series data)
	9	期中報告
	10	Data exploration (spatial data)
11	Data exploration (multiple variables)	

	12	Data exploration (distributions)	
	13	Presentation clarity (hierarchy and readability)	
	14	Presentation clarity (highlighting and annotation)	
	15	Presentation clarity (design principles)	
	16	Scientific communication (writing a manuscript)	
	17	Scientific communication (preparing a talk)	
	18	期末報告	
六、成績考核	期中報告、期末報告、出席表現		
七、講義位址 http://	Moodle 平台		

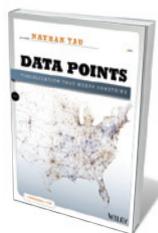
Drawing out the meaning

Felice Frankel relishes an inspired handbook on the art and science of picturing data.

Scientists, probably more than most, are aware of the ever-increasing presence of data visualization in newspapers, television, online shopping, social media and even policy-making sales pitches in the US Congress. I'll bet there's a brand new office building in Washington DC devoted to creating chart-laden poster boards for congressional members. Statistician and visualization expert Nathan Yau's *Data Points: Visualization That Means Something* is a clear and passionate exploration of this burgeoning phenomenon.

A detailed handbook, *Data Points* is especially useful for those working on scientific data visualization, guiding the reader through fascinating examples of data, graphics, context, presentation and analytics. But this is more than a mere how-to manual. Yau reminds us that the real purpose of most visualization work is to communicate data to pragmatic ends. He points to the other end of the spectrum: visualizations created by those so seduced by artful design that meaning becomes inconsequential. As Yau writes of statistics and design knowledge, "having skills in both provides you with the luxury — which is growing into a necessity — to jump back and forth between data exploration and storytelling".

Yau entices us to look and think, study, dissect and judge. As a visualizer himself, he has made intelligent choices of illustrations in this wonderfully varied collection; they are not there as decoration. Lokesh Dhakar's *Coffee Drinks Illustrated* (<http://go.nature.com/tcxs21>), for instance, is accessibly simple, yet rich in information. Yau includes an interactive astronomical visualization by Santiago Ortiz (<http://go.nature.com/hwnsdX>) as an example of how perspective and context are inseparable when zooming and rotating the night sky. The visualization of constellations is both elegant and beautiful, and could become an inspiration for scientists creating interactive molecular configurations. And although there are few



Data Points: Visualization That Means Something

NATHAN YAU
John Wiley & Sons: 2013.
384 pp. \$39.99/£26.99

specifically scientific visualizations on offer, the creative researcher could find much to adapt in these approaches.

Yau illustrates and discusses the fundamental components of visualizations and how small changes can improve readability.

concept or data into a formatted representation — that is, to reduce a visual expression to its fundamental information — is one of the least discussed but most important elements of successful visual representations.

I have some quibbles. You might need a magnifying lens while reading *Data Points*: a number of the figures need considerable enlargement to make sense on the printed page. And ensure you view online his many examples of visualizations intended for online publication, especially those intended for interactivity. I would also have liked to see a more in-depth discussion on representing uncertainty. We are all aware of the

various levels of imprecision in our data, and not to communicate that somehow in our representations can be irresponsible — but that exercise probably warrants a separate book. Finally, I found it annoying that many figures do not appear next to where they are referenced in the text; I sometimes had to turn a page or even two to see what Yau was describing.

But this remains a masterpiece. I can imagine some initial eye-rolling in the visualization community on the first viewing of some of Yau's seemingly 'obvious' examples. But there is much to learn from studying what Yau does here. That is, defining and demonstrating good visualization with clarity and precision as "a representation of data that helps you see what you otherwise would have been blind to if you

looked only at the naked source... trends, patterns, and outliers that tell you about yourself and what surrounds you".

Thank you, Nathan Yau, for helping us to begin. ■

Felice Frankel is a research scientist in the Massachusetts Institute of Technology's Center for Materials Science and Engineering in Cambridge, Massachusetts, USA. Her latest book is *Visual Strategies: A Practical Guide to Graphics for Scientists and Engineers*, co-authored with Angela DePace. e-mail: felfra@mit.edu

Visual Cues			
	Position	Length	Angle
Patterns			
Increase			
Decrease			
Combination			
Outlier			

Characteristics abstracted into form: each cell combines two properties of data.

He teaches us to think graphically. On one spread (and there are many), he cleverly uses the 'visual cues' described by William Cleveland and Robert McGill in their 1985 study on graphical perception and methods (W. S. Cleveland and R. McGill *Science* **229**, 828–833; 1985) in a table that subtly encourages the reader to think their way into visual abstraction (section pictured). The table shows patterns in data — such as an increase or decrease in the population of a species — and how these can be represented graphically through angle, position, area or colour saturation. How to visually abstract a