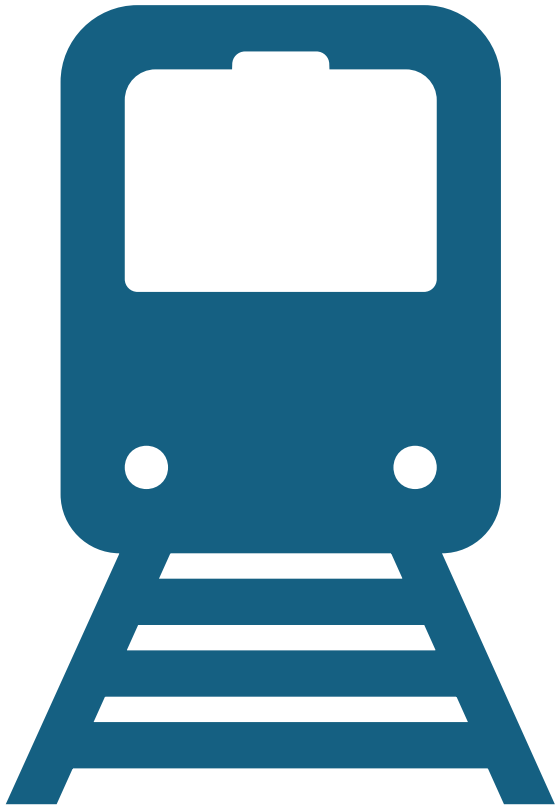
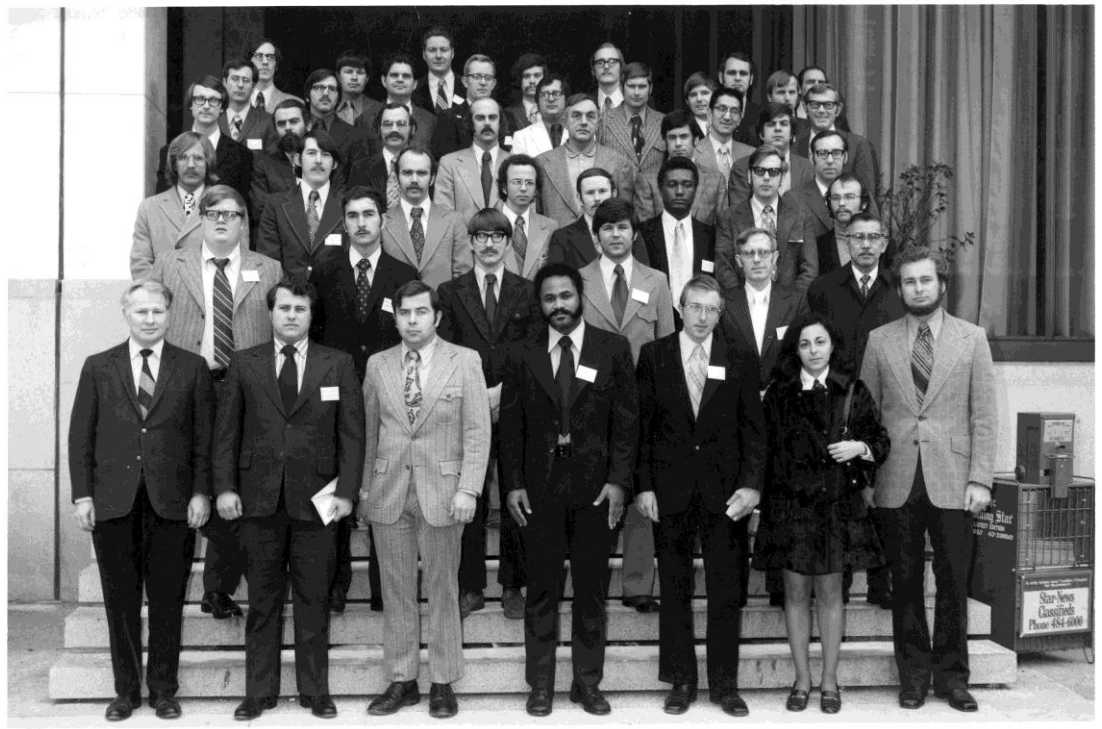
Three Generations of Travel Modeling: Where We've Been and Where We're Going



Where Did I Start with Models?

1973



FRONT ROW: F. Clark, W. Davies, S. Blue, C. McCants, R. Kolb, A. DeBiase, A. Schroder III; SECOND ROW: S. Adkins, R. Gorman, S. Wallace, K. Kaltenbach, G. Ellis, K. Toda; THIRD ROW: M. Zdon, R. Watson, K. Jones, J. Tucker, D. Keck, J. Marshall, R. Brown, D. Morris; FOURTH ROW: P. Linden, S. Gray, Jr., D. Strohbusch, P. Patneaude, A. Batchelder, K. Bingham, W. Keller, Jr., D. Smith; FIFTH ROW: (right side) R. Karasawa, H. Skinner; SIXTH ROW: T. Weeks, D. Hawley, A. Lebeau, C. Ricks, C. Rodriguez, J. Isaacson, W. Evans, J. Stevens; BACK ROW: W. Otto, A. Hughes, J. McClain, R. Warner, S. Burnham, T. Adams, C. Case

APPLICATION OF GRAVITY AND INTERVENING OPPORTUNITIES MODELS TO RECREATIONAL TRAVEL IN KENTUCKY

By

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Director of Thesis

Don J Wood
Director of Graduate Study

April 14, 1972
Date

2002

Why do we do this?

KEY OBJECTIVES

- **Infrastructure Planning**: Helps in designing and developing transportation infrastructure like roads, bridges, and public transit systems to meet future demand.
- **Policy Making**: Assists policymakers in making informed decisions about transportation policies, such as congestion pricing, tolls, and public transit subsidies.
- **Environmental Impact**: Evaluates the potential environmental impacts of transportation projects, helping to minimize negative effects on the environment.
- **Economic Analysis**: Supports economic analysis by estimating the benefits and costs of transportation projects, ensuring efficient allocation of resources.
- **Traffic Management**: Aids in managing traffic flow and reducing congestion by predicting where and when traffic will be heaviest.

Were these always the reasons?

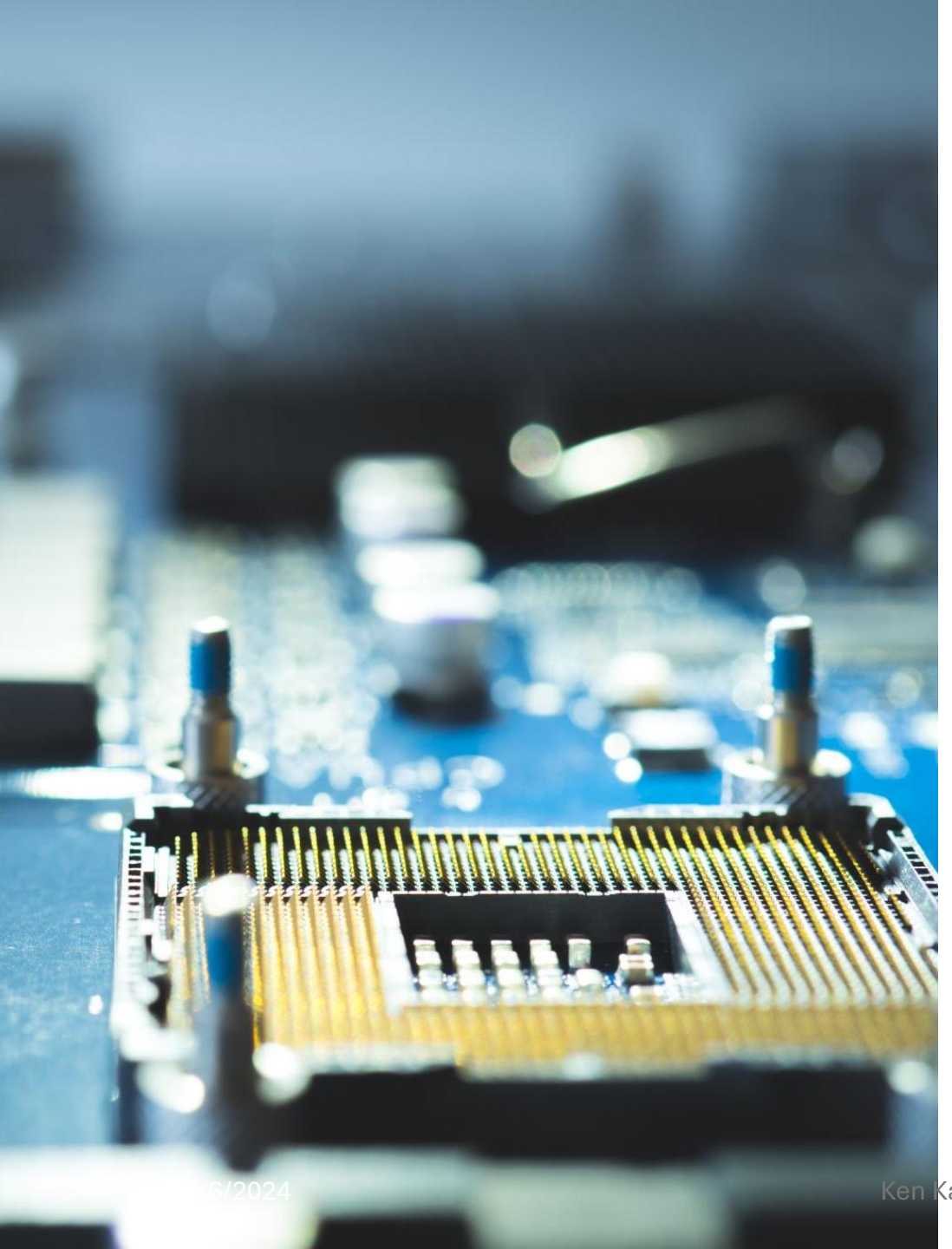
- **President Eisenhower 1956 …** (WWII German autobahn).
- **Original Reason:** Interstate Highway System (National Interstate and Defense Highways). The four-step model (FSM) was created to predict future traffic patterns, including the number of trips, their destinations, modes of transportation, and routes used.
- **In most cases:** Transit, non-motorized trips, freight travel, were of little interest.
- **Some interest:** Long-distance trips on interstates and rail systems.
- **Even today:** Many DOT's of largely rural states focus only on highways.
- **USDOT Funding:** 56% goes to highways and bridges (2024 budget).
- **Ohio DOT: 81.7%** goes to highways and bridges (2024 budget).

Why did it change?

- **One big reason (not the only one):** The National Environmental Policy Act (NEPA) was signed into law by President Richard Nixon on **January 1, 1970**. It was enacted to ensure that federal agencies consider the environmental impacts of their actions and decisions.
- We had to consider **more** than just highways!

Travel Demand Modeling changed over time (or constant change is here to stay!)

- Need to solve more complex urban problems.
- Declining ability of highways to provide answers.
- Demand due to technology.
- Better hardware and tools.
- No more stick maps (Ok, a minor issue)!

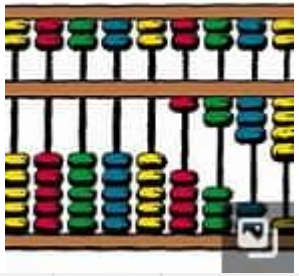


So, what has the journey been like?

- When?
- What did we do, what were the tools?
  - Computer
  - OS
  - Platform
  - Scripting
  - Hardware
  - Approaches/Why

How to Calculate

dec	HEX	bin
0	0	0
1	1	1
2	2	10
3	3	11
4	4	100
5	5	101
6	6	110
7	7	111
8	8	1000
9	9	1001
10	A	1010
11	B	1011
12	C	1100
13	D	1101
14	E	1110
15	F	1111
16	10	10000



dec	bin	Product	HEX
1	0	0	
2	0	0	8
4	0	0	
8	1	8	
16	0	0	
32	1	32	
64	1	64	E
128	1	128	
256	1	256	
512	1	512	7
1024	1	1024	
2048	0	0	
Sum=		2024	

HEX	bin	DEC
7E8	111111011000	2024

QUBITS anyone? Qubits can exist in two states simultaneously -> probabilistic output of a classical bit.

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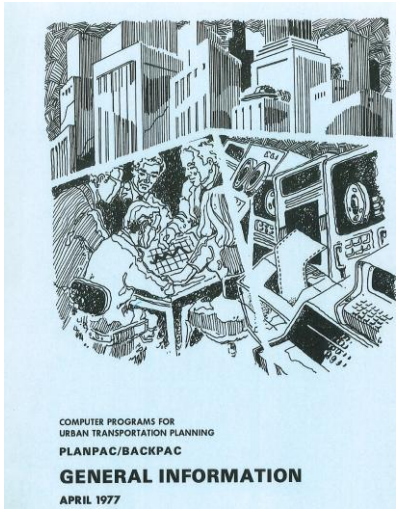
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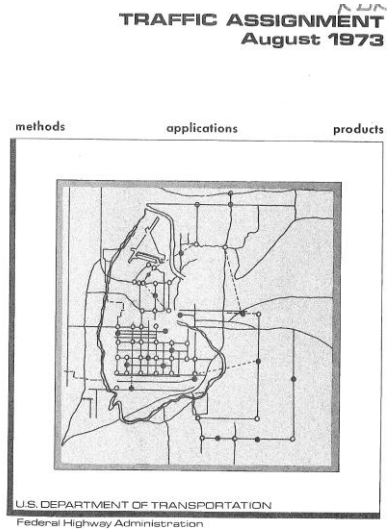
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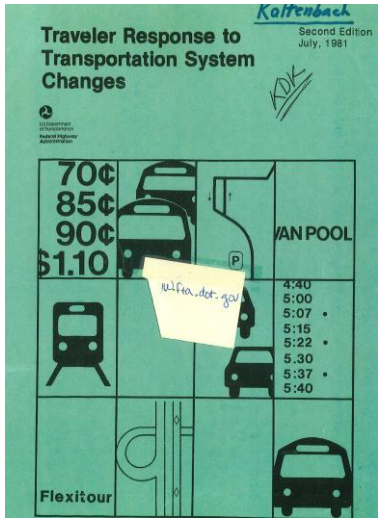
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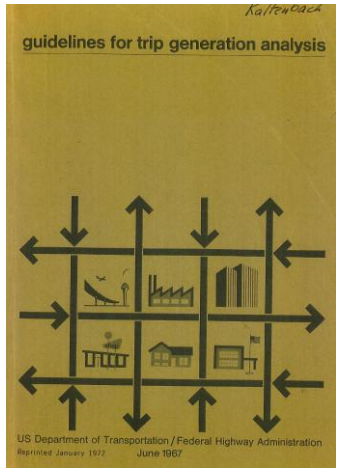
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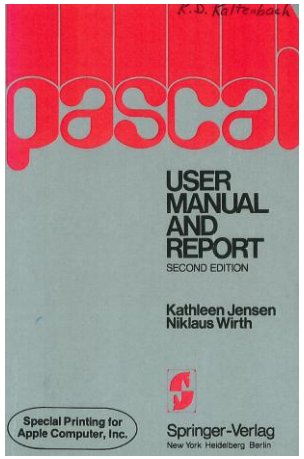
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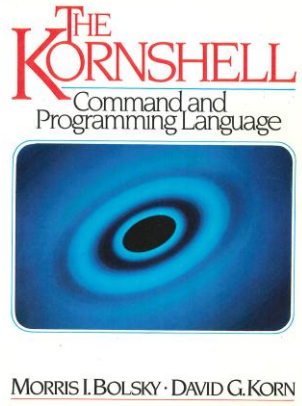
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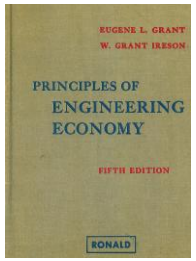
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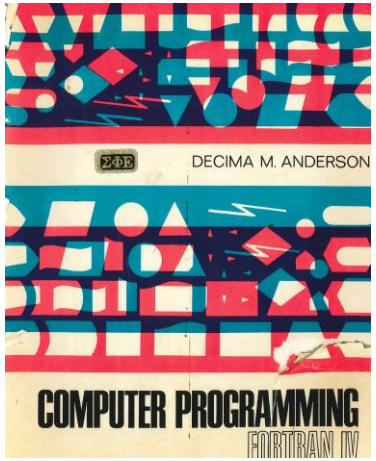
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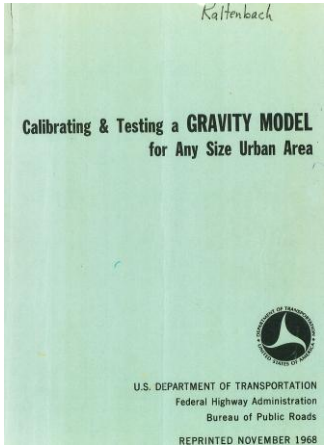
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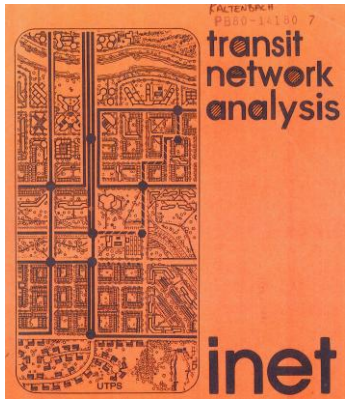
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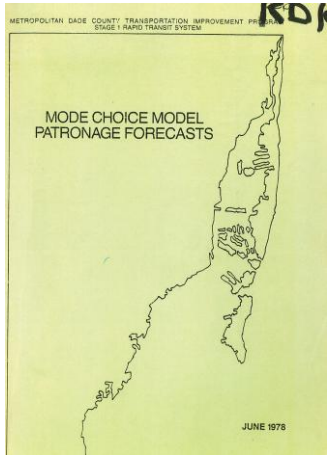
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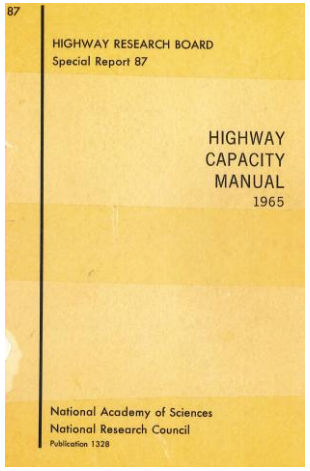
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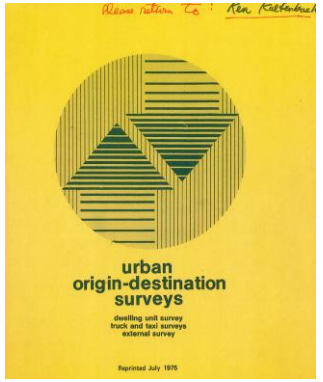
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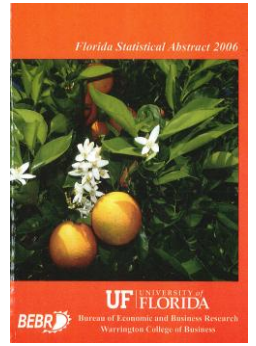
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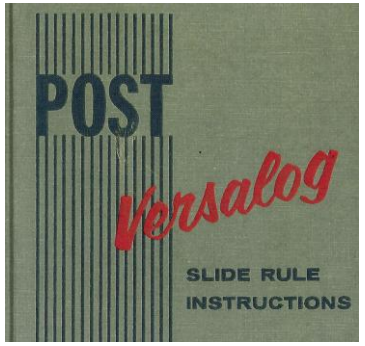
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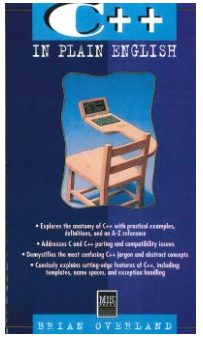
C++
IN PLAIN ENGLISH
BRIAN OVERLAND

Tools in the 1970's

YEAR	Computer	OS	Platform	Scripting	Hardware	Approaches/Why
1965	Moore's law	IBM OS		Assembler	punch cards	integer Skims and
	IBM 7090/7094		BPR programs	FORTRAN	mag tape	Trip Tables
		JCL				HHOD> 12.5%
	IBM 360	IBM full OS			Diskpacks	External OD roadside Interviews
		UNIX	Planpac			Model vehicles
						Shirley Highway Managed Lanes
1970					Paper pen Plots	Model: fixed vs variable records net TAZ
	IBM 360/370					NEPA
			UTPS			
1975					dial-up modems	Most editors not full-screen
	Motorola 6502			Basic	Floppy disks	Accuracy vs precision
	Apple II	Apple DOS				
1980	Lisa		microUTP			Micro speeds competive with Mainframe
				Pascal		Early Spreadsheets
	Intel 8088		Tranplan	dBase	Mouse	Much smaller sample sizes
	IBM PC	MSDOS/PC DOS	minUTP			
	Apple MAC					
1985			EMME/2 (Inro)	C++	CRT Plots	Most editors full screen
		Windows 1.0	TransCAD - dos			IBM ISPF
		OS/2; AIX				
			QRS II			TIGER FILES
1990						8,192 max hwy links
	HDD's > 500mb	Linux		Python		Desktop GIS becomes available
			PT+; VISUM			Digital Maps
				R scripting		

On to the 1980's

YEAR	Computer	OS	Platform	Scripting	Hardware	Approaches/Why
1965	Moore's law	IBM OS		Assembler	punch cards	integer Skims and
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		UNIX	Planpac			Model vehicles
1970					Paper pen Plots	Model: fixed vs variable records net TAZ
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	Apple II	Apple DOS				
1980	Lisa		microUTP			Micro speeds competive with Mainframe
				Pascal		Early Spreadsheets
	Intel 8088		Tranplan	dBase	Mouse	Much smaller sample sizes
		MSDOS/PC DOS				
	IBM PC		minUTP			
	Apple MAC					
1985			EMME/2 (Inro)	C++	CRT Plots	Most editors full screen
			TransCAD - dos			
		Windows 1.0				IBM ISPF
		OS/2; AIX				
			QRS II			TIGER FILES
1990						8,192 max hwy links
	HDD's > 500mb					
		Linux		Python		Desktop GIS becomes available
			PT+; VISUM			Digital Maps
				R scripting		

YEAR	Computer	OS	Platform	Scripting	Hardware	Approaches/Why
			CUBE			No practical TAZ & Link limits
1995	Mainframe	Windows 95		Java		
	more or less gone		TransCAD windows			New software is floating point
	IBM RS/6000	Windows 98				
						BIG DATA emerges
2000		Windows 2000			thumb drives	actvity-based models
	RISC gone	Windows XP			Big external HHDs	Monte Carlo simulation
					1090p monitors	Aggregation errors
					hardwired internet	
	broadband internet					
2005						GTFS for transit begins
	PC's with multi cores/64 bit Intel i7 chips					
	iPhone	Windows 7				
2010						Miami Managed Lanes
	ssd's become common					C/AV's become an issue
						STOPS released
2015	moores law prevails	Windows 10				
2020	Intel i9	Windows 11				Natural Language Processing Artificial Inteligence
2025						

What's to Come?

- We don't see much C/AV yet, but we will. Might be a while. VMT will increase.
- Big Data will become better and more available. I hope it can be sanitized to include travel characteristics.
- Integration of Big Data and AI.
- More manageable Activity-based/tour models.
- Computers will get even faster and provide better graphics.
- AI will help us and provide more understandable outputs for policy makers.
- Autos will be cleaner. Hope their price will fall.
- Replacement for the gas tax.
- Urban transit will be better and will prevail.
- Better consideration of Sustainability and Environmental Considerations, Resilience and Adaptability.
- I hope we will quit carrying fuel around with us.