

Parkalot

Using parking apps like traditional meters
using license plate validation loopholes

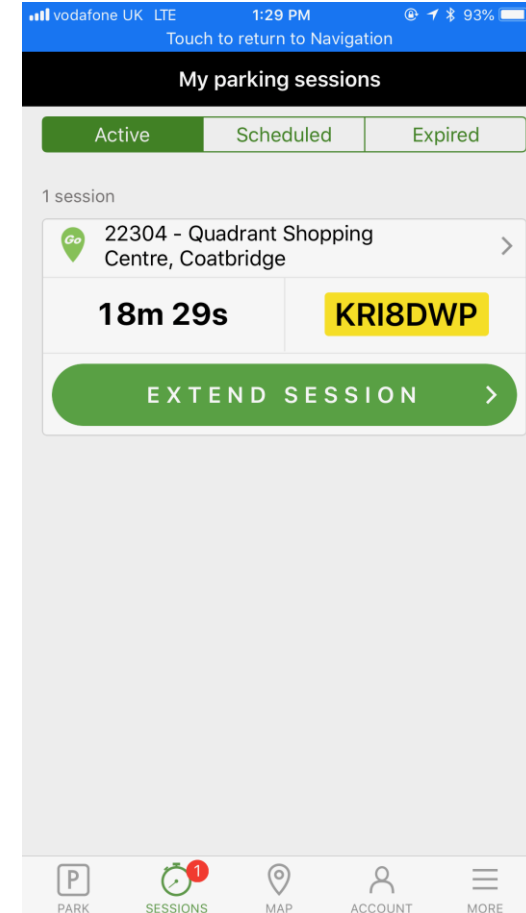
Michael Rudden
ShmooCon 2023

Disclaimer

- I talked to people from both Passport Parking and the City of Raleigh, and what I am about to discuss is **not** an application flaw in Passport's app nor any municipal system.

Relevant background

- I am a Security Engineer by trade
- I live in Raleigh, NC
Population: ~467,000
- Raleigh uses Passport Parking to handle metered parking downtown
- NC allows special characters in personalized license plates
- Mine has a '\$' in it
- In 2018 I got a parking ticket in Scotland the first time I parked the rental car

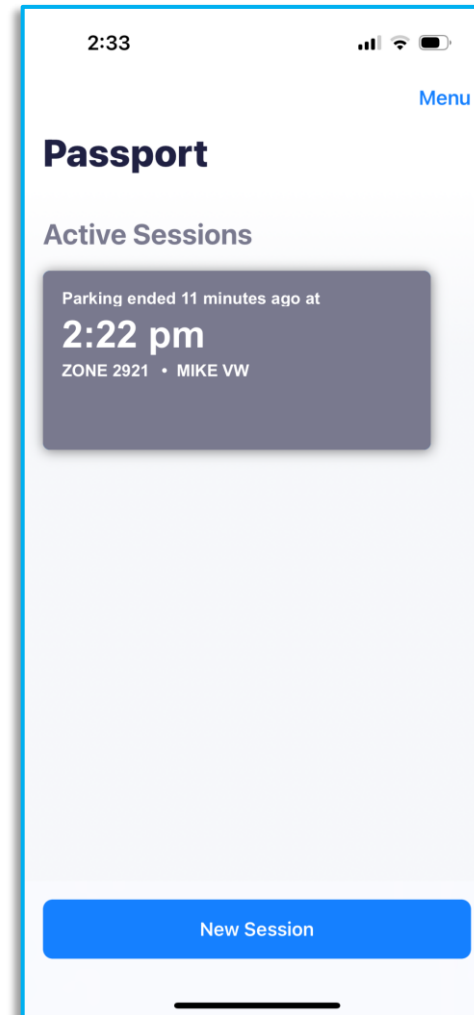
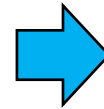
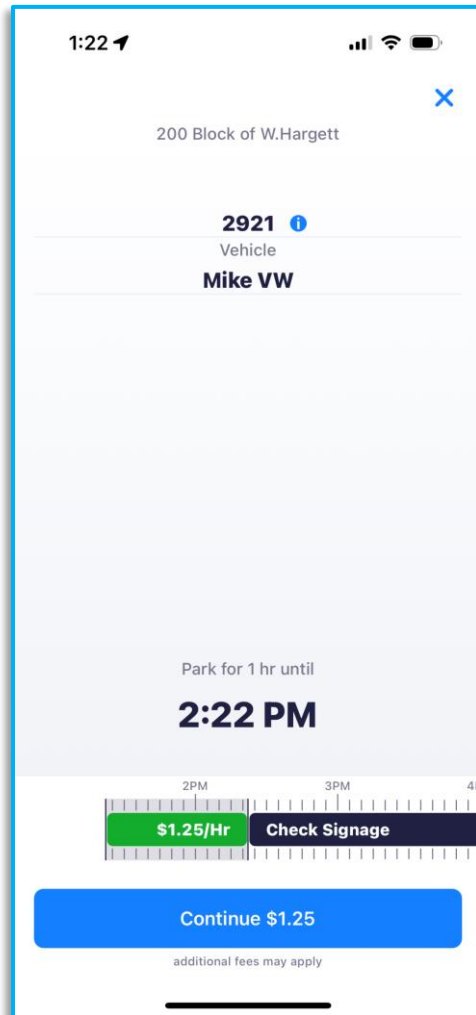


Scenario – Present day

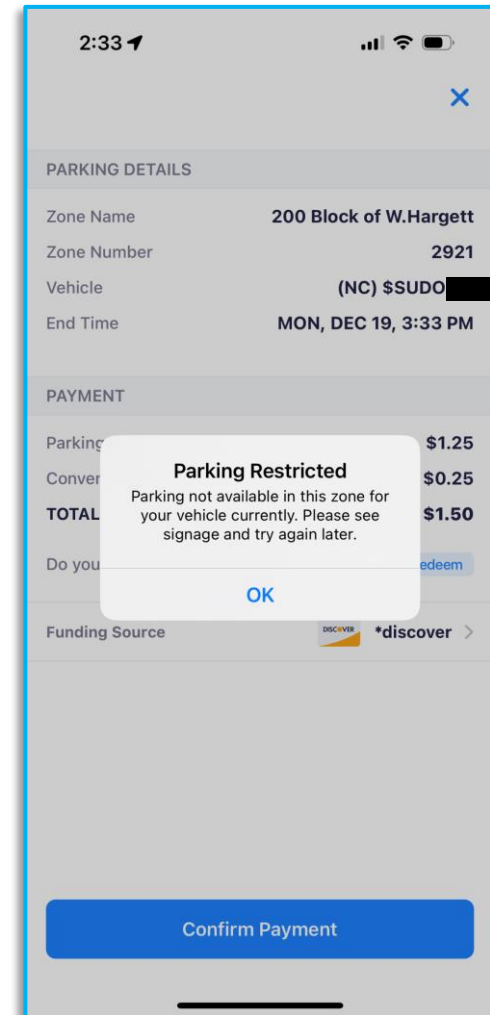
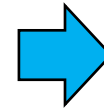
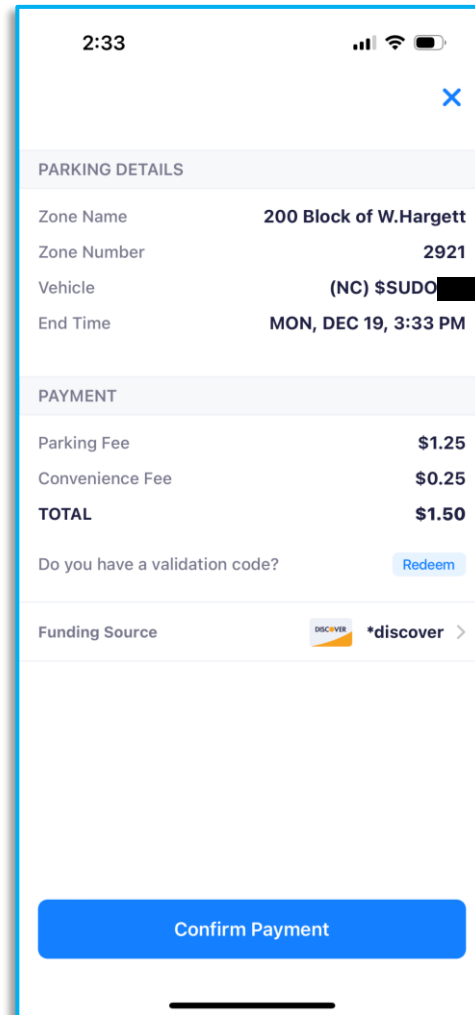
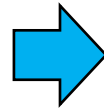
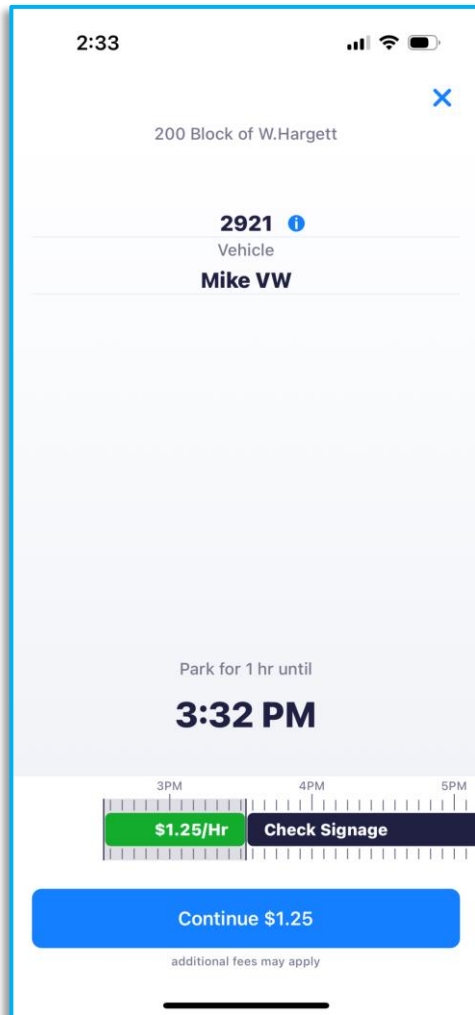
- I drove to city hall for a meeting
- I'm parking in a 1-hour metered parking zone directly across from the building
- The meeting starts at 1:30 and I may need to be there longer than an hour
- Raleigh has Passport parking so the app will notify me and I can top off the session... right?



1. I buy an hour of parking, it expires



2. I attempt to renew, and am blocked



Let's go back in time

What would we have done prior to Passport implementation in 2019?

- Put some more quarters in the meter
- Move the car a few spaces over
- Rub a chalk line off your tire



Hacking around the limitations

Starting with a deep dive into NC License Plate syntax

Isn't it time you made a name for yourself?



APPLICATION FOR PERSONALIZED LICENSE PLATES
 Personalized plate fee \$30 in addition to annual renewal fee. Please remit \$30 check with application.

Vehicle type: automobile private truck commercial vehicle
 trailer motorcycle (7 digit limit) moped (7 digit limit)

Plate type: First in Flight* First in Freedom* National/State Motto*

Owner's Name: Last _____ First _____ Middle (Full) _____

Mailing Address _____

City _____ State _____ Zip Code _____

Phone (8 a.m. to 5 p.m.) _____

Current Plate # _____ Expiration Date _____

Title # _____

Vehicle Identification # _____

Owner's Signature _____ Date _____

DMV Use Only

ISN'T IT TIME YOU MADE A NAME FOR YOURSELF?
 Now's your chance to join thousands of North Carolinians and show the world what you think, who you are or almost anything else. Be original, be creative! Use up to eight characters to design your own license plate.

By investing in a personalized license plate, you are supporting the following important programs.

- The Clean Water Management Trust Fund
- The Roadside Wildflower Planting Program
- N.C. Travel and Tourism Promotion
- Handicapped Access Guide to N.C.

Characters that count as 1 space:
 Ampersand (&), Number Sign (#),
 Single Quotes ('), Plus Sign (+),
 Dollar Sign (\$), Slant Line (/),
 Equal Sign (=), Asterisk (*),
 Question Mark (?), At Sign (@)

Characters that count as 1/2 space:
 Apostrophe ('), Dash (-),
 Comma (,), Exclamation Point (!),
 Colon (:), Period (.)
No 1/2 spaces are allowed on motorcycle plates.

Characters that count as 2 spaces:
 Double Quotes ("")

Characters that count as 1 space:
 Ampersand (&), Number Sign (#),
 Single Quotes ('), Plus Sign (+),
 Dollar Sign (\$), Slant Line (/),
 Equal Sign (=), Asterisk (*),
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First Choice

--	--	--	--	--	--	--	--	--	--

Second Choice

--	--	--	--	--	--	--	--	--	--

Third Choice

--	--	--	--	--	--	--	--	--	--

*Available for a private passenger and a private hauler vehicle licensed for 6,000 pounds or less.

There are no 1/2 space characters for motorcycle license plates.



Source: NC DMV

Side note: Os and Os are the same character in North Carolina



Personalized Plates Special Characters Guide

The below list indicates which special characters are allowed. The amount of space a character occupies is subtracted from the number of characters allowed on the plate. Personalized Plates require at least one letter or one number. There are no ½ space characters allowed for motorcycle license plates.



Description	Character	Amount of Space
Ampersand	&	1.0
Number Sign	#	1.0
Question Mark	?	1.0
Dollar Sign	\$	1.0
Forward Slant	/	1.0
Equal Sign	=	1.0
Asterisk	*	1.0
Plus Sign	+	1.0
At Sign	@	1.0
Empty Space		1.0
Exclamation Point	!	0.5
Colon	:	0.5
Period	.	0.5
Dash	-	0.5
Comma	,	0.5
Apostrophe	'	0.5
Double Quotes	"	1.0
Ampersand	&	1.0
Number Sign	#	1.0
Question Mark	?	1.0
Dollar Sign	\$	1.0
Forward Slant	/	1.0
Equal Sign	=	1.0
Asterisk	*	1.0
Plus Sign	+	1.0
At Sign	@	1.0
Empty Space		1.0
Double Quotes	"	1.0

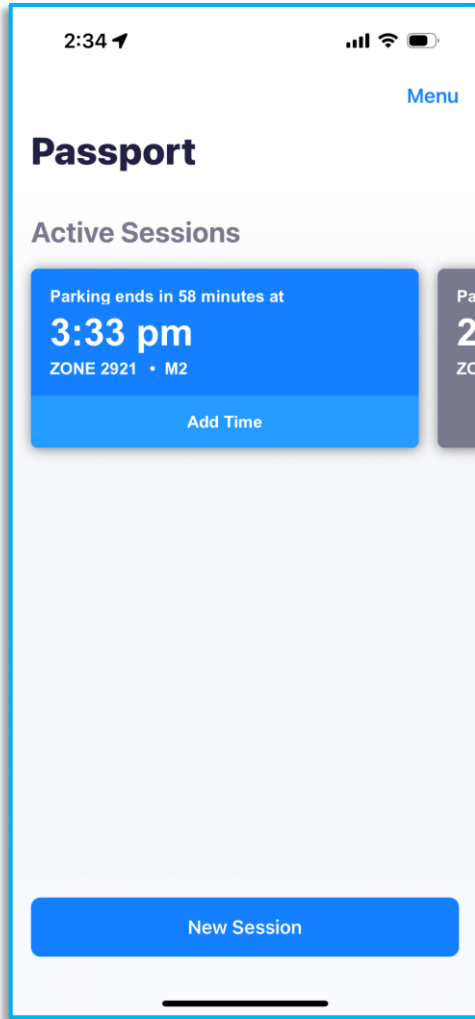
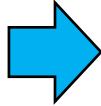
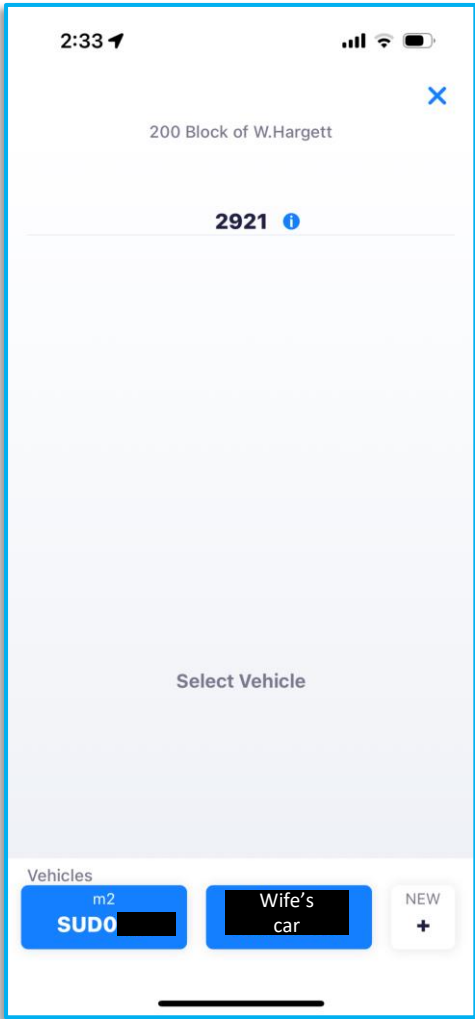
Note: Special characters will not be considered when determining whether the plate text is available. For example, plate A&3@C is the same as A3C.

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Key takeaways

1. A special character is the same as a space, and a space is the same as nothing at all
2. Every license plate number with a special character in it can be expressed 3 different ways

Let's try the same plate another way (no '\$')



It works!

Thinking and going beyond



- Every non-personalized, non-specialty plate in North Carolina has a hyphen in the middle
- This means every standard issue NC plate can be expressed as 3 valid numbers
- Not every parking system can handle all the characters, so you need to know the other forms of your plate number

Other considerations

- Os and 0s are the same in North Carolina
- Specialty plates have their own formats



Prepare for unforeseen consequences

What happens if parking enforcement comes around?

- If:
The detected plate exactly matches a paid plate, you're good
- If else:
The parking staff does a manual check
- Else:
You get a ticket
- Raleigh writes <5% of people parking each year a citation (~1.5 million transactions, 40-60k citations)

Workaround: The appeals process

- Sometimes people pay the zone next to the one they're parked in, but it's an easy mistake
- Don't want to ticket Purple Heart veterans for missing the little "PH" on their plate
- 60% of appeals are accepted

Final thoughts

A lot of security concepts carry over into parking management:

- Entitlements – by space (old way) vs. by car (new way)
- Automated detection and handling false negatives
- Rules-based enforcement that can be hard to apply consistently across different vendors and tools
- Input validation and sanitization
- End-user awareness and training
- Regulatory requirements

That's all, folks

Special thanks to

- The City of Raleigh
- Passport Parking

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