Description: The Taxicab Problem: Clip 5 of 5: Extending the Taxicab Correspondence to Pizzas with Toppings and Binary Notation **Parent Tape: Taxicab** **Date: 2000-05-05** **Location: David Brearley High School** **Researcher(s): Carolyn A. Maher, Arthur B. Powell**	**Transcriber(s): Powell, Arthur; Milonas, Jeremy** **Verifier(s): McGowan, Will; Brookes, Elijah** **Date Transcribed: Spring 2010** **Page:** 1 **of** 8

1		T/R3	Uh, my question was you said that you found Pascal's triangle here and um, it wasn't clear to me that if you go, let's take-
2		MICHAEL	Do you want a like reason why- how it relates?
3		T/R3	Yeah.
4		ROMINA	Okay.
5		MICHAEL	Not because it looks like it? You want to know why.
		ROMINA	Now we just picked any point. Let's say we picked this point. No matter how you get to this point-
		MICHAEL	Do the six one. The six one-
		ROMINA	Well we'll do the six and the four.
		MICHAEL	All right.
		ROMINA	Okay, to this point you know you need to take at least you have to take four moves. That's the shortest amount of moves because just like a simple one, two, three, four. So that means it's- let's say you we're relating back to this four moves equals four blocks. So I'd have to go down to the four block area. So that's one, two, three, four. [Pointing to the fourth row of her Pascal's triangle.] And now here you're going three across and one down. Or- so- [Illustrating the moves on the taxi grid and pointing to the numbers on the grid and redrawn triangle.]
		MICHAEL	There's no possible way you could-
		ROMINA	//Do anything else.
		MICHAEL	//You have to- no matter how or which way you go you have to go three and then one.
		ROMINA	Right. In any move you're going one down and three across no matter- in any direction you take. So the three across and one down, that would relate to three colors and then-
		MICHAEL	Of one-
		ROMINA	Three of one color and one of another. So you

			go and you look in here. Say- Okay, here's with all one color. This is with one of one color-
		MICHAEL	That's- that's nothing.
		ROMINA	No that's all one color but we're not using that because you can't all go all in the same direction. That's all one color. That's with one of one color and three of the other. So that's four and that's what we have and if you go down to here this is two and two and this is three and one which is the same thing. So there's your other four. And if you go to the sixth, the only way you can get there again is by four moves. It goes one- one, two, three, four. So you're in the four block again but this time you have to take, no matter what you do, you go two across and two down anyway you do it. So that would be two and two which is your six but you're still in like the four block area. [Relating the taxi grid to Pascal's triangle.]
		MICHAEL	Like you know what the uhm- let me write this down. Like when you write the Pascal's triangle, this is really like- like- all right, let's say-
		ROMINA	[Inaudible].
		MICHAEL	Let's say it's like, uh- I don't know how to say it- like, um, like a pizza or something. All right, you have a choice of four toppings.
		T/R3	Okay.
		MICHAEL	All right. This one is the pizza with nothing. So you'll only- there's only one possibility without any toppings on the pizza. [Pointing at the triangle.]
		T/R3	Uh hum.
		MICHAEL	Now if you have one choice of topping you get four. I see it but I don't know how to like say

			it. [Waving both hands.]
		T/R3	Maybe you can help me see how you're relating the number of toppings and the number of //blocks.
		MICHAEL	//To this?
		T/R3	Yeah. To the- get- getting to any- to a particular corner.
		MICHAEL	I like see something and I- if I say it'll- it'll make it a lot clearer but I just don't- don't know how to say it.
		T/R3	Why don't you just try saying it?
		MICHAEL	All right. Well- I'm trying to think of like a- a way//
		ROMINA	//Mike, if we were to use pizza could you explain this 'cause I don't know how to do this, okay, that means you have four toppings- [Pointing with Michael to the 4th row of the triangle.]
		MICHAEL	This is, um,- Yeah, four toppings.
		ROMINA	//Plain. [Pointing to the 1st number in the 4th row.]
		MICHAEL	//You have one topping, you're going to make //four different kinds of pizzas.
		ROMINA	//One topping. //Two toppings. [Pointing to the 2nd # in the 4th row]
		MICHAEL	//Two toppings. [Pointing to the 3rd #]
		ROMINA	//Three toppings. [Pointing to the 4th number]
		MICHAEL	//You can make six.
		ROMINA	Four toppings. [Pointing to the 5th number]
		MICHAEL	Yeah.
		ROMINA	All right. So, you can do that. Just do-
		MICHAEL	Don't know where to go from there though. Like how to relate toppings to that.
		ROMINA	Just the same way I just did with the blocks. It's the same thing.
		MICHAEL	All right, think of a topping as like, um, being

			able to go across so if you're only able to go across one time then you could do it four different ways and-
		ROMINA	That's one topping.
		MICHAEL	Here. You could do this- This- this one right here. Go across this time and go down this time and go down and this time and that time. The rest is all going down. The rest of your moves are all going down. [Tracing moves on grid]
		T/R3	So you're say one topping-
		MICHAEL	Yeah. Yeah, one topping would be like you're only able to walk across or go across or drive across actually it's a taxi, one time- one block.
		T/R3	Okay.
		MICHAEL	Now the six would mean you're able to drive two blocks across and two down. Um, four would be you're able to drive three across and the last- and this one right here is you're able to drive- wait four, um, you're able to drive four across which- I mean, drive four down- no, nothing across. I'm trying- I'm trying to say- I can't really say-
		BRIAN	Good job.
		MICHAEL	Yeah, this would mean you would drive nothing across. It wouldn't even get you to that- wouldn't even get you there. So, that's why, you know, the ones don't really count in our- in our like model. Like- [motioning with fingers in air and pointing to redrawn triangle and grid triangle]
		ROMINA	The ones- the ones //would be if you just could-
		MICHAEL	//The only thing-
		ROMINA	-if you're going just to this point because it's only you're only going in one direction. Like you can't get to any of the inside points

			because you have to use two directions.
		MICHAEL	Yeah. So on the odd do you see like four-
		T/R3	What I understood you say- you're saying is that the number of toppings related to-
		MICHAEL	To the number of times you go across.
		T/R3	Okay. So that one that you have at the corner there-
		MICHAEL	This one right there? [Pointing to a number in the redrawn triangle]
		T/R3	Uh hum. How many toppings is that one?
		MICHAEL	That's all the toppings. But you really- you can't get there by going all- you know- um-
		ROMINA	Those would be like the across- toppings.
		MICHAEL	Yeah. This one actually- this would be, uh, all toppings, which would really mean all down.
		T/R1	So are you telling me that some of those are across and some of those are down?
		MICHAEL	Yeah, like how I was saying it.
		ROMINA	This one would be two across- [Pointing at 4 in the triangle]
		MICHAEL	No, no. This would be one across and- [pointing at 4 in triangle]
		ROMINA	One across, yeah.
		MICHAEL	-and three down. All right? That's- [Pointing at one by three in grid]
		ROMINA	No-
		MICHAEL	No, one across and three down. [Pointing at grid]
		ROMINA	Yeah, that one
		MICHAEL	All right, this one you go two across and two down and three across and one- and one down. [Pointing at grid]
		T/R1	So how does that work with the A's and the B's and the toppings? So I see what you mean by across and down but now if I'm thinking of *A*s and *B*s or *x*'s and *y*'s, right. Would you say

			that just one more time? I know that you've said it.
		MICHAEL	I- I said it?
		T/R1	No. Somehow it came out of the conversation. Somebody said it.
		BRIAN	Romina was bringing it up.
		ROMINA	Um, I'm sorry. What am I trying?
		BRIAN	*x*'s and *y*'s like-
		T/R1	I think it was Romina who did it, yes. She used *x*'s and *y*'s for acrosses and downs.
		ROMINA	Okay, so if we're doing the same one with, um, with no- no *x*'s then you'd have to go four down- four *y*'s down and that would be this one. [Motioning across and down on grid] But you're not going to get there. Whatever. But if you're trying to get there it's one *x* and then you go three *y*'s. So that's your four. If you're trying to get to this one over here it's two *x*'s, two *y*'s then three *x*'s, one *y* and they're all- they all equal four but they all have different amounts of *x*'s and *y*'s and that's how we get this. Yes? No? [Referring to the drawing of Pascal's triangle.]
		T/R3	And the *x*'s and *y*'s- What does *x* correspond to again?
		ROMINA	//*x* is across.
		BRIAN	//Going across. And *y* is //down.
		ROMINA	//Or a topping or a color. All the same thing. And all our *y*'s are down, toppings, color.
		T/R1	Could you use zeros and ones?
		ROMINA	Sure.
		T/R1	How does that work
		ROMINA	That's his area.
		MICHAEL	I don't believe it.
		BRIAN	Come on Mike.
		T/R1	s that Michael's area?

		ROMINA	Come on Mike. Zero, one.
		BRIAN	//Break out the binary.
		T/R1	//Does that work with zeros and ones?
		MICHAEL	Uh man, I haven't seen that in a while. Uh, I really gotta remember.
		ROMINA	Well just- the same thing-
		MICHAEL	Oh like-
		ROMINA	One would be every time across-
		MICHAEL	Yeah, one-
		ROMINA	Zero would be every time down.
		MICHAEL	Just- All right, this- right there. This group is, you know, everything that has one, one and two zeros. [Writing binary codes
		T/R1	Uh hum.
		MICHAEL	That's that. The next one would be- [Writing binary codes
		T/R1	//Mm hm.
		MICHAEL	//or two across' and one down there's a zero. That's a, is that good?
		T/R1	I don't know. Is that another way?
		MICHAEL	Do you- like do you see how you can relate the zeros //across and down.
		BRIAN	//The same thing.
		T/R1	Brian- //Brian thinks-
		MICHAEL	The one moving across and the zero would mean down.
		T/R1	Romina?
		ROMINA	Yeah, see I can't work like that. I work in, um, towers.
		T/R1	You're working in towers.
		ROMINA	He works in pizzas and binary.
		T/R1	Brian are you- work both ways Brian?
		BRIAN	No. No I'm totally not a binary kid. I don't-
		ROMINA	We- see me and Brian were absent when we did binaries in like sixth grade.
		BRIAN	I missed a week.

		ROMINA	We obviously weren't there.