> Having investigated the practical impact of inaccuracy and error I can use my knowledge of tolerance when choosing the required degree of accuracy to make real-life calculations.
> **MNU 4-01b**
> I can apply my knowledge and understanding of measure to everyday problems and tasks and appreciate the practical importance of accuracy when making calculations
> **MNU 4-11a**

Error Checking: Credit Card Algorithm

Credit cards have a unique 16-digit number. To avoid the cardholder or bank writing down or entering these digits wrongly the *Codabar system* is used. Using this simple algorithm we can identify whether a credit card number is valid or not. The first 15 digits are part of a code and the final digit is called the "check digit" and this confirms with almost 100% accuracy whether the card is valid or not!

The Codabar Algorithm works like this:

Step 1: Take the first 15 digits.

Step 2: Add all the digits in the even positions. Write down this number.

Step 3: Add all the digits in the odd positions and double your answer. Write down this number.

Step 4: Count how many digits in the odd positions are greater than 4. Write down this number.

Step 5: Add the three answers you received in Step 2, Step3 and Step 4.

Step 6: The 16th digit on the card is whatever you would need to add to your total to make a multiple of 10.

Example:

Do these Credit Cards have valid 16-digit card numbers?

	VISA card		Mastercard
Step 1	First 15 digits: 135289745651324	*Step 1*	First 15 digits: 150482673510929
Step 2	Add even position digits: 3+2+9+4+6+1+2 = **27**	*Step 2*	Add even position digits: 5+4+2+7+5+0+2 = **25**
Step 3	Add odd position digits and double: 1+5+8+7+5+5+3+4 = 38 38 x 2 = **76**	*Step 3*	Add odd position digits and double: 1+0+8+6+3+1+9+9 = 37 37 x 2 = **74**
Step 4	Count the odd position digits greater than 4: **5** (they are 5,8,7,5,5)	*Step 4*	Count the odd position digits greater than 4: **4** (they are 8,6,9,9)
Step 5	Add the answers from Step 2, Step 3 and Step 4: 27 + 76 + 5 = **108**	*Step 5*	Add the answers from Step 2, Step 3 and Step 4: 25 + 74 + 4 = **103**
Step 6	What would you add to get to a multiple of 10? It should be a **2**	*Step 6*	What would you add to get to a multiple of 10? It should be a **7**
	This matches the credit card's check digit so this is a valid number!		**This doesn't match the credit card's check digit so this is an invalid number!**

Exercise 1:
Use the Codabar Algorithm to decide whether or not the following would be valid Credit Card numbers.

a) 2356 7789 1032 8872   b) 6040 9560 0083 1083
c) 4128 0012 3456 7896   d) 4162 0012 3456 7893
e) 4128 0012 4389 0110   f) 1078 8823 6011 5543

Of course, given the first 15 digits of any Credit Card you can now calculate what the check digit should be (a very impressive trick at parties I've found).

Example:
What should the check digit be for the following Credit cards?
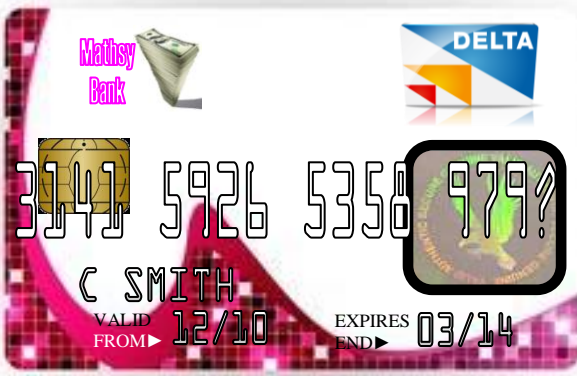
Step 1	First 15 digits: 314159265358979	Step 1	First 15 digits: 987654321012345
Step 2	Add even position digits: 1+1+9+6+3+8+7 = **35**	Step 2	Add even position digits: 8+6+4+2+0+2+4 = **26**
Step 3	Add odd position digits and double: 3+4+5+2+5+5+9+9 = 42 42 x 2 = **84**	Step 3	Add odd position digits and double: 9+7+5+3+1+1+3+5 = 34 34 x 2 = **68**
Step 4	Count the odd position digits greater than 4: **5** (they are 5,5,5,9,9)	Step 4	Count the odd position digits greater than 4: **4** (they are 9,7,5,5)
Step 5	Add the answers from Step 2, Step 3 and Step 4: **35** + **84** + **5** = **124**	Step 5	Add the answers from Step 2, Step 3 and Step 4: **26** + **68** + **4** = **98**
Step 6	What would you add to get to a multiple of 10? It should be a **6**	Step 6	What would you add to get to a multiple of 10? It should be a **2**
For this credit card, the check digit must be a 6.		**For this credit card, the check digit must be a 2.**	

Exercise 2:
Use the Codabar Algorithm to decide what the check digit must be to complete these Credit Card numbers.

a) 1123 7785 6676 110☐   b) 2468 1357 8642 753☐
c) 1491 6253 6496 481☐   d) 2357 1113 1719 232☐
e) 4045 6623 3143 889☐   f) 2771 8977 4521 777☐

Secure Exercise:
a) Write down a valid 16 digit credit card number. Switch the order of any two digits. Show that this new number is not a valid credit card number.

b) Research any patterns in the digits of VISA, Mastercard and American Express cards. How do these companies make their card numbers distinctive?

Error Checking: Credit Card Algorithm

Answers:

Exercise 1
 a) INVALID. Check digit should be an 8.
 b) VALID.
 c) VALID.
 d) INVALID. Check digit should be a 1.
 e) INVALID. Check digit should be a 5.
 f) VALID.

Exercise 2
 a) Check digit must be 3.
 b) Check digit must be 9.
 c) Check digit must be 5.
 d) Check digit must be 6.
 e) Check digit must be 1.
 f) Check digit must be 0.

Secure Task
 a) Proof.
 b) VISA cards start with a 4, American Express start with 34 or 37, Mastercard start with 5.