Implementation assignment - MACD trading system specificaton
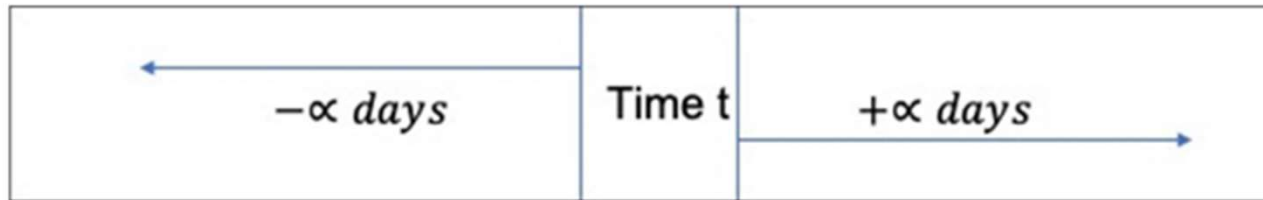
Stock – S and P 500 daily closing price 2016 to 2021

What is a moving average?

This is the average of a time series over a specific window size which slides along as we move along the time series.

$$SMA(t) = \frac{t_{-\propto} + \cdots t_{-1} + t + t_1 + \cdots + t_{\propto}}{2 \propto + 1}$$

where $2 \propto + 1$ is the window size

However, we are unable to have access to future value in a time series hence we look at simple moving average using past data.

A window {t-T, t) is now used as basis of the computation of SMA. This gives a lag to the actual movement average value. The computation with the (t-T, t) sliding window is effectively the MA at t-T/2. Essentially this is the arithmetic moving average computed by summing the values of the series over the window period and averaging this using the size of the window.

SSMA = (p(t-T) + p(t-T+1) + p(t-T+2) … + p(t-2) + p(t-1) + p(t))/(T+1)

MACD Model

To address the lag due to lack of foresight data, an exponential moving average that weighs the more on recent data is used.

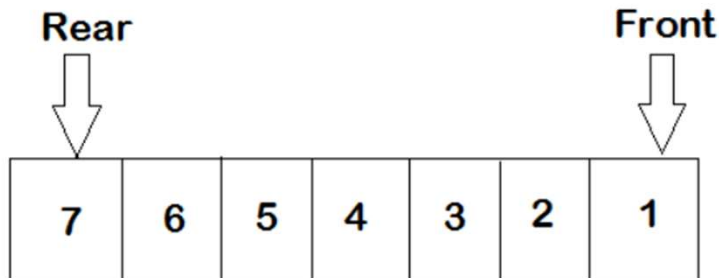The formula for the Exponential moving average is:
EMA = (today's closing price *K) + (Previous EMA * (1 – K))
N = number of days in EMA
K (Smoothing Factor) = 2/(N+1)

For a long EMA of 26 Days, N = 26 and for a short EMA of 12 Days, N=12.

Queue – special data structure that can be used as a FIFO queue or FILO - stack

Rear   Front

| 7 | 6 | 5 | 4 | 3 | 2 | 1 |

- **put(item):** This will put the item inside the queue.
- **get():** This will return you an item from the queue.
- **empty():** It will return true if the queue is empty and false if items are present.
- **qsize():** returns the size of the queue.
- **full():** returns true if the queue is full, otherwise false.

The **Rear** represents the point where the items are inserted inside the queue. The **Front** represents the point where the items from the queue will be removed. This forms a FIFO queue

Python Queue: FIFO, LIFO Example (guru99.com)

Queue – special data structure that can be used as a FIFO queue or FILO - stack

Rear   Front

7	6	5	4	3	2	1
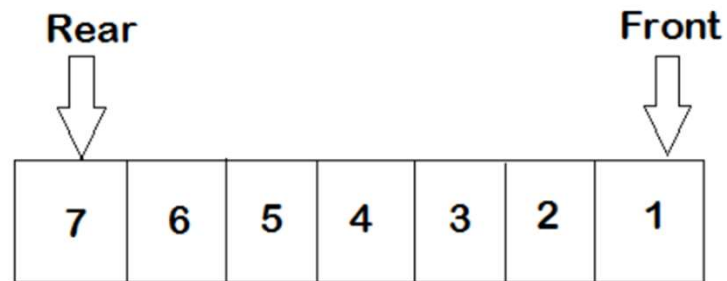
FILO/LIFO queue - last in the first out queue, the element that is entered last will be the first to come out. - STACK

Sample Queue

Add and item in a queue

```
import queue
q1 = queue.Queue(5) #The max size is 5.
q1.put(1)
q1.put(2)
q1.put(3)
q1.put(4)
q1.put(5)
print(q1.full()) # will return true.
```
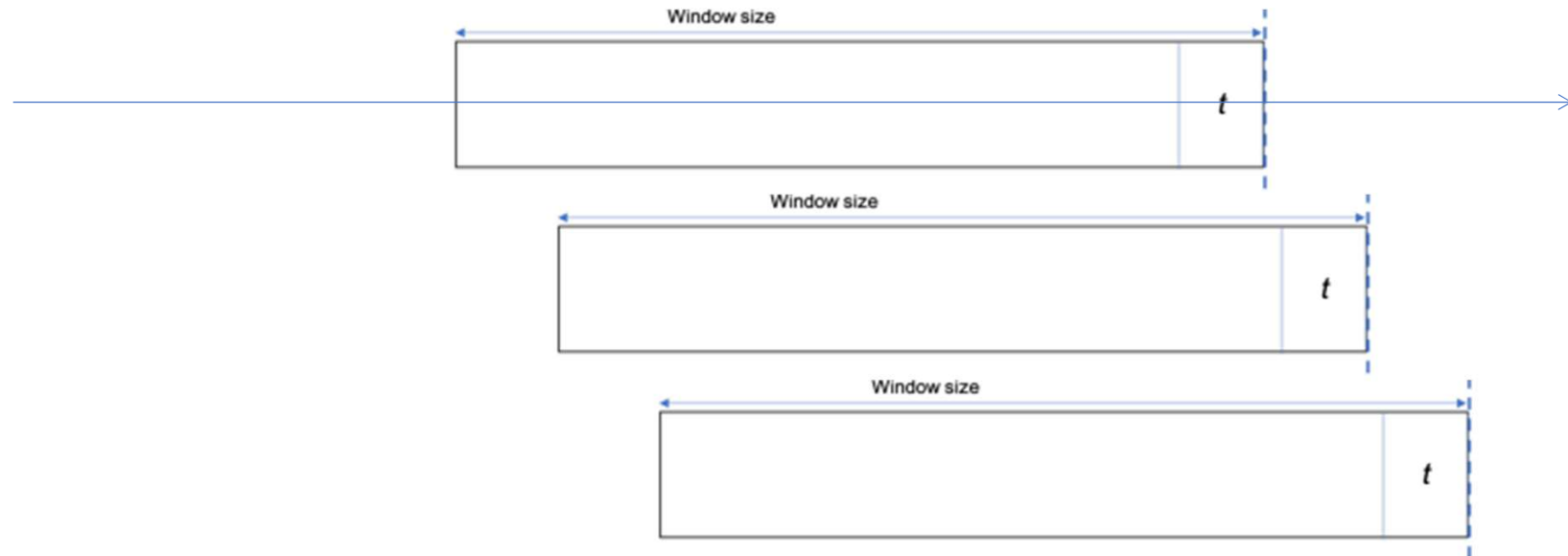
Remove an item from the queue

```
import queue
q1 = queue.Queue()
q1.put(10)

item1 = q1.get()

print('The item removed from the queue is ', item1)
```

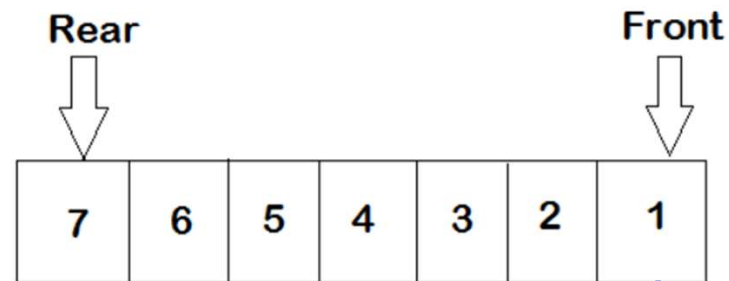# Standard Simple Moving Average

The MA window is shifted 1 day at a time and the MA is computed accordingly.
How to use a queue to implement the SMA computation in each window frame?

Standard SMA

$$SSMA(t) = (p(t-T) + p(t-T+1) + p(t-T+2) \ldots + p(t-2) + p(t-1) + p(t))/(T+1)$$

For a(T+1) day moving average

$$SSMA(t+1) = (SSMA(t)*(T+1) - p(t-T) + p(t+1))/(T+1)$$

For a(T+1) day moving average

slido

What should you do first on the queue to implement the computation of SSMA at time (t+1)?

ⓘ Start presenting to display the poll results on this slide.

EMA – Initialisation - computation

	Date	Close	
1	Date	Close	
2	2016-01-04 00:00:00	201.02	
3	2016-01-05 00:00:00	201.36	
4	2016-01-06 00:00:00	198.82	
5	2016-01-07 00:00:00	194.05	
6	2016-01-08 00:00:00	191.92	
7	2016-01-11 00:00:00	192.11	
8	2016-01-12 00:00:00	193.66	
9	2016-01-13 00:00:00	188.83	
10	2016-01-14 00:00:00	191.93	
11	2016-01-15 00:00:00	187.81	
12	2016-01-19 00:00:00	188.06	
13	2016-01-20 00:00:00	185.65	192.935
14	2016-01-21 00:00:00	186.69	

	A	B	C	D	E
1	**12 -Day EMA of XOM**				
2	http://investexcel.net				
3					
4	Date	Close			
5	1/2/2013	42.42			
6	1/3/2013	43.27			
7	1/4/2013	43.66			
8	1/7/2013	43.4			
9	1/8/2013	43.4			
10	1/9/2013	44.27			
11	1/10/2013	45.01			
12	1/11/2013	44.48			
13	1/14/2013	44.34			
14	1/15/2013	44.44		=AVERAGE(B5:B16)	
15	1/16/2013	44.08			
16	1/17/2013	44.16	43.91083		
17	1/18/2013	44.04			

	Date	Close	
1	**Date**	**Close**	
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$$EMA(t) = (Price(t) * K) + \big(EMA(t-1) * (1-K)\big)$$

$$\text{where } K = {^2}\!/_{Window\ Size + 1}$$

MACD Model

MACD line = S-MA – L-MA (MA can be SMA or EMA of the time series)
**9-MACD-MA** is the signal line (MA can be SMA or EMA of the MACD)
MACD Histogram = MACD – 9-MACD-MA (+ve = bullish and –ve = bearish)

1) When the signal line crosses over the MACD line (That is the histogram changes from +ve to –ve) it represents a trend reversal turning bearish

2) When the signal line crosses under the MACD line (that is the histogram changes from –ve to +ve) it represents a trend reversal turning bullish

MACD and MACDH
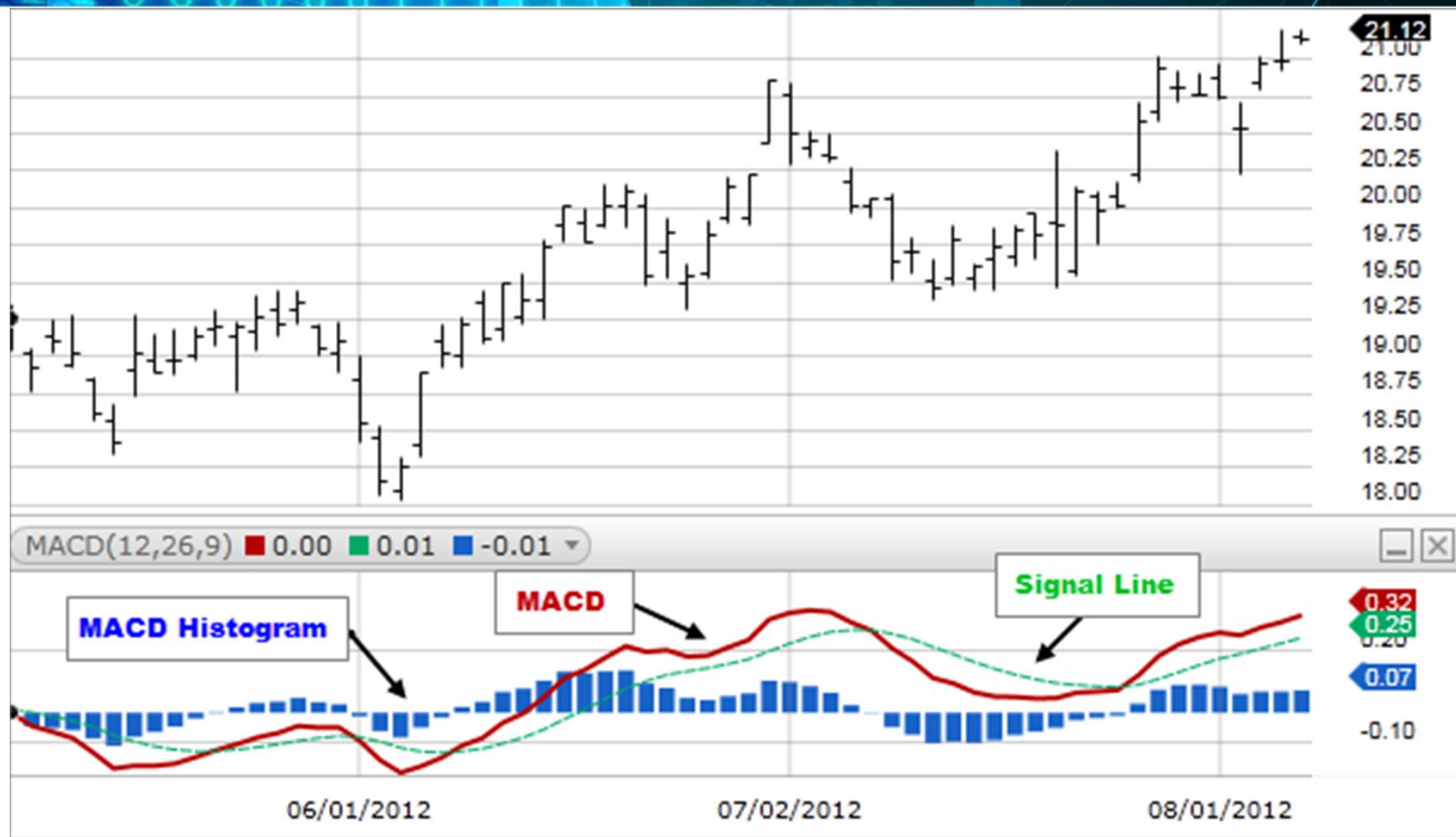
Each trend reversal can be accompanied by a Buy for Bullish market – condition 2 or a Sell for Bearish market – condition 1.

Each pair forms a BUY-HOLD-SELL action and incur commission loss at the BUY and SELL position determined by the cross over of the signal line.

In a BUY and HOLD investment, the Long position is held over the duration of investment and no opportunistic BUY and SELL are considered during this investment holding period. Hence only 2 commission loss are incurred in standard BUY and HOLD strategy.

MACD and MACDH
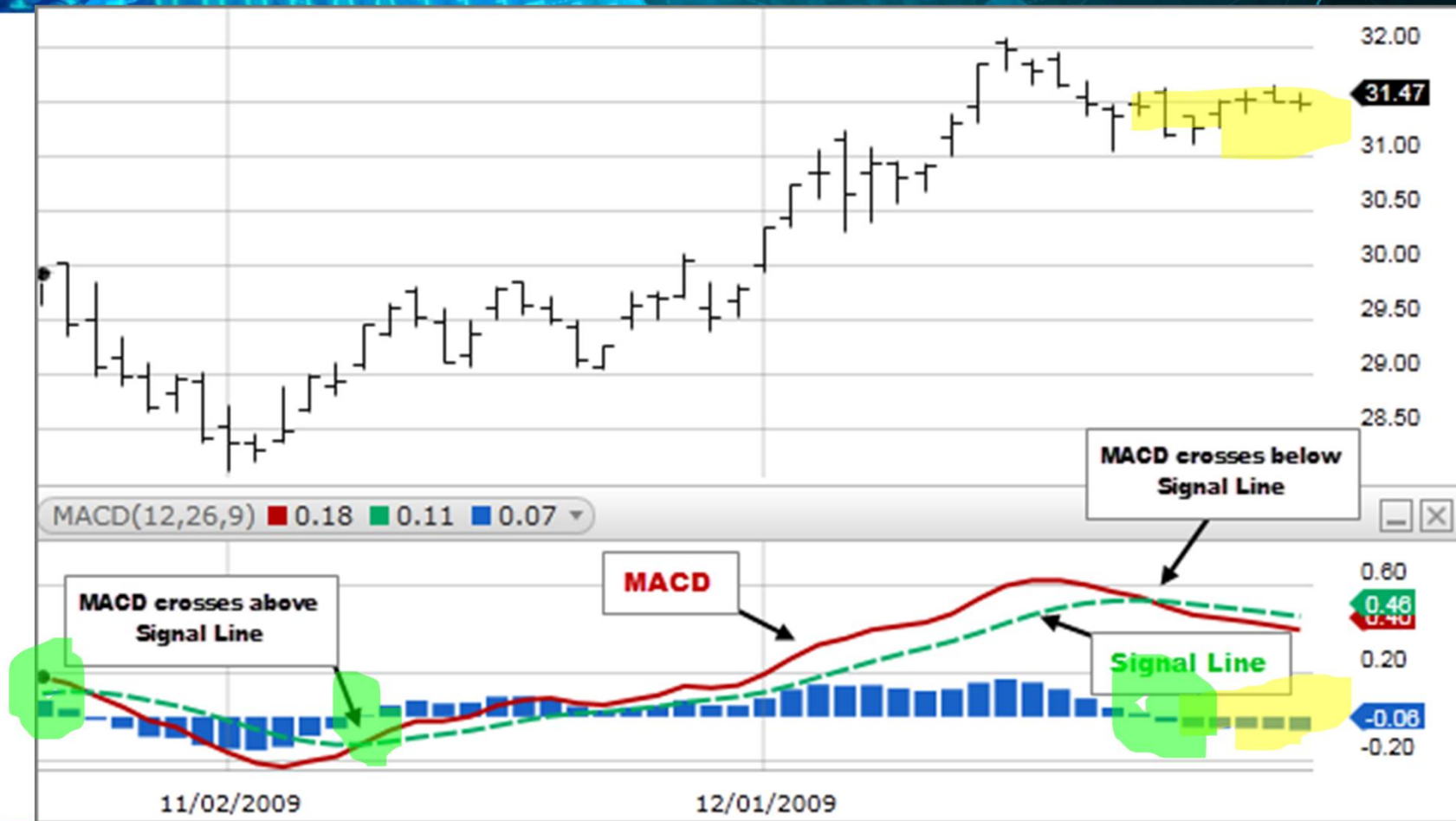
How effective is MACD trading during a fully bullish market with minor market correction?

ⓘ Start presenting to display the poll results on this slide.

S and P 500

Implementation Specification

MACD trend reversal model using the exponential Moving average for Long and Short can be used within the MACD trend reversal model.

Based on your design in assignment 1 implement the MACD trading model using the S and P 500 daily closed data set provided as an excel file.

The following are to be used:

S-MA = 12 days

L-MA = 26 days

Commission = 1/8 percent per trade.

Initial capital = US$100,000.00

Consider cumulative investment at each trade where profit is reinvested in full.

Duration of trading is over the period of the whole S and P 500 dataset provided.

At each trend reversal:
1. The Signal line crossing under the MACD line - a buy signal is given to initiate a BUY and when
2. The Signal line cross over the MACD line a sell signal is given to initiate a SELL

Compute the BUY and SELL pair through the trading cycle with a commission at each trade done during each of the trend reversal BUY/SELL position. Assume all the holdings are bought or sold with all the accumulated fund. The stock series is stored in a text or excel file.

Also in your design compare your profit/loses against a simple BUY-HOLD-SELL position over the entire period of the trend reversal trading

S and P 500

Design Implementation – cont'd

Prepare a report 5-6 pages on the design and implementation of such a trading system with block diagram using flow chart and pseudo code and highlighting key functions and data structures

Readability and maintainability of your code is a key component in the assessment

Include a script of the run of your code which allows one to select which financial excel data file to be used – generality of code.

Design Implementation – cont'd

It should include the following in the summary computed in the run :

    total number of trades made using MACD

    average return per trade using MACD

    relative gain/loss against the long term Buy-Hold-Sell strategy
using the MACD model with SSMA and EMA models.

Optional:

If we intend to reduce unnecessary trade due to weak trend reversal
what must be added to your design? Explain this with your result
with this additional filter for unnecessary trades

Submission:

Send design report to:

computationalsc1003@gmail.com

Report Filename: *name_assign2.docx* or pdf # report
Src_code_Filename: *name_assign2_code.docx* /pdf/txt
            # src code – this naming avoid the check via mail
Run-Script Filename: *name_assign2-script.docx* or pdf.

Deadline: 14th March 2022 (3 weeks)

Reading and Writing to an Excel file

How to read and write from/to a text file

https://www.pythontutorial.net/python-basics/python-read-text-file/

https://www.pythontutorial.net/python-basics/python-write-text-file/

How to read and writ from/to an Excel file

https://www.pythontutorial.net/python-basics/python-read-csv-file/

https://www.pythontutorial.net/python-basics/python-write-csv-file/

https://pythonbasics.org/read-excel/

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