FE570 Financial Markets and Trading

Lecture 8. Technical Trading Strategies

(Ref. Anatoly Schmidt *CHAPTER 10 Technical Trading Strategies*)

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Outline

Technical Analysis (TA) is a field comprising various methods for forecasting the future direction of price.

- Based on analysis of past prices, but may also rely on other market data, such as trading volume and volatility (Kaufman 2005).
- A very popular tool for pattern recognition prior to the pervasive electronic computing era. It is in conflict with the Efficient Market Hypothesis, but it is still recognized by many from both practitioners and academic community (Menhkoff & Taylor 2007, and Lo et al. 2000).
- Were profitable until 1980s and 1990s, but their performance has been deteriorated in recent years (Kerstner 2003, Aronson 2006, and Neely et al. 2009)
- However, what keeps TA alive seems to rest on the fact that it offers uncountable opportunities for modifying trading strategies, and hence, there is always a chance for success.

Reasons for Continued Success:

- TA strategies are generally determined by several input parameters and there are no hard rules for determining them.
- Another possible venue for increasing the profitability of TA is diversification across different trading strategies and/or instruments.
  - Timmerman (2006) concludes that simple forecasting schemes, such as equal-weighting of various strategies, are difficult to beat.
  - Several trading strategies can be used simultaneously for the same asset (Kaufman 2005).
  - Hsu & Kuan (2005) considered three strategies along with several technical rules including moving average and channel break-outs.
  - Okunev & White (2002) tested three TA strategies for a portfolio consisting of up to seven currency pairs and found that this diversified portfolio outperformed returns from a single currency pairs.

More development:

- Dempster and Jones (2001) developed a real-time quantitative trading system based on six technical indicators and it generates positive returns with statistical significance.
- Wilcox and Crittenden (2005) diversified portfolio assets rather than trading strategies (24,000 securities for 22 years).
- Neely et al. (2010) suggested mixing trend strategies with an economic-variable model. TA can be used in combination of fundamental value modeling techniques.
- Yang et al. (2017) proposed a Genetic optimization approach to combine the technical indicators with a sentiment strength indicator to find trade-off of timing and accuracy of the information.
- In recent years, there are attempts to apply classical TA strategies and AI to intraday price dynamics; and some have also include other sources of data such as news, social media, blogs, and financial disclosures, etc.

Trend Strategies:

Trend strategies can be defined with the foundamental idea: *Buy low, sell high*. The question then is how low is *low* and how high is *high*. In other words, defining the market entry and market exit points remain a real challenge.

- **Filter Rules** - The filter rule is based on a certainty in price momentum, or the belief that rising prices tend to continue to rise and falling prices tend to continue to fall.
- **Moving-Average Rules** - Two moving averages (the short and long one) are compared to make a trading decision.
- **Channel Breakouts** - A channel (or band) is an area that surrounds a trend line within which price movement does not indicate formation of a new trend. Trading strategies based on the channel brekouts are fomulated based on the breakouts.
- **Complex Geometric Patterns** - Complex patterns represent a challenge for quantitative description.

Filter Rules.

- According to the simple *filter* rule, one should buy/sell at the next opening if the last closing price P_k is higher/lower than the previous closing price P_{k-1} by a certain threshold $\delta > 0$

$$\text{Buy: } P_k/P_{k-1} > 1+\delta$$
$$\text{Sell: } P_k/P_{k-1} < 1-\delta$$

In a more generic format, the highest/lowest prices for a given past period of length n are used for the trading decision (Talor 2005). Namely,

$$\text{Buy: } P_k/M_k > 1+\delta$$
$$\text{Sell: } P_k/m_k < 1-\delta$$

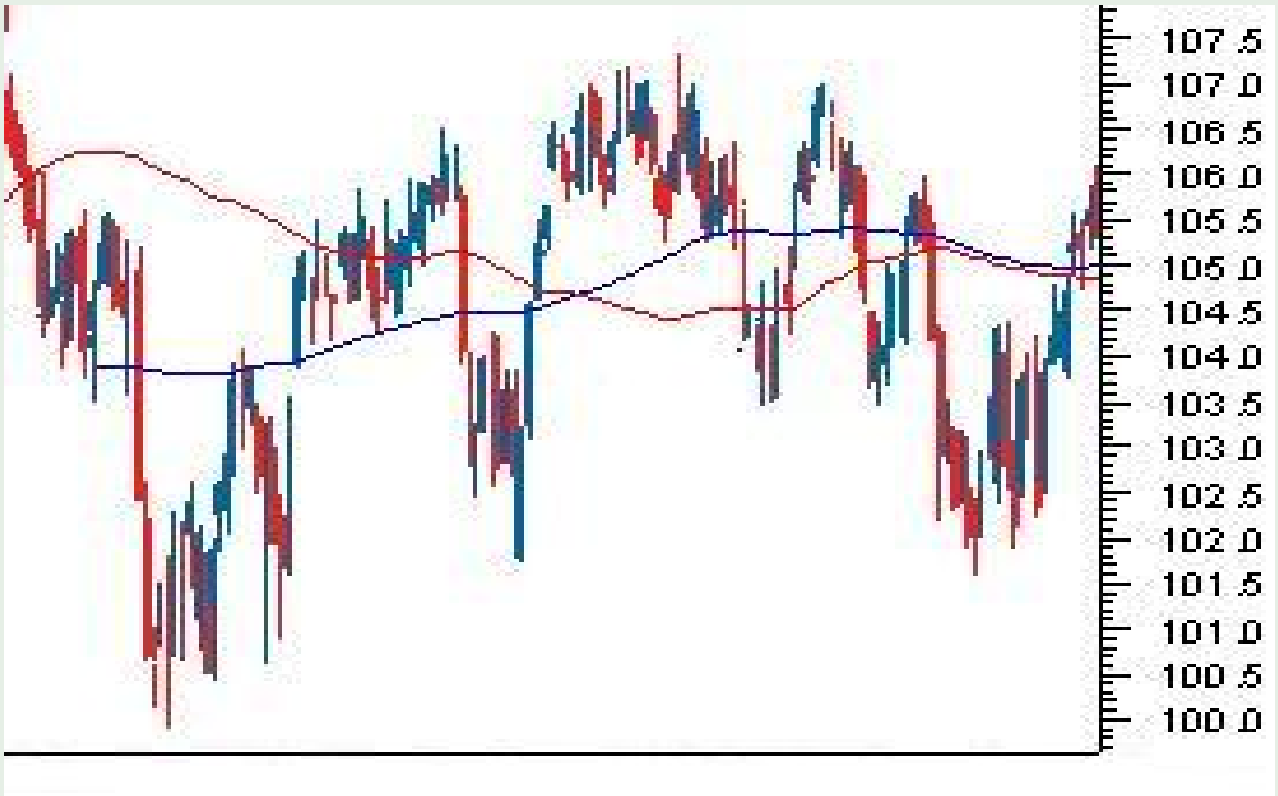
where

$$M_k = \max(P_{k-1}, ..., P_{k-n}), m_k = \min(P_{k-1}, ..., P_{k-n})$$

Example

Filter Rule Example

- Two research studies of filter rules from 0.5 to 20% found that only the 0.5% filter rule could generate above-average returns, but because of the high transactions costs associated with the frequent trading necessitated by the rule, the investor would not actually come out ahead.



Moving-Average Rules

- Let's denote SMA over n lagged periods at time t with $sma(P_t, n)$:

$$\text{sma}(P_t, n) = (P_{t-1} + P_{t-2} + ... + P_{t-n})/n$$

and consider the relative difference between the short-term (fast) $sma(P_t, S)$ and the long-term (slow) $sma(P_t, L)$:

$$r_t = [\text{sma}(P_t, S) - \text{sma}(P_t, L)]/\text{sma}(P_t, L)$$

- The moving-average strategy generates the following trading signals:

$$\text{Buy: } r_t > \delta$$

$$\text{Sell: } r_t < -\delta$$

Moving-Average Rules

- Simple moving-average may be replaced with exponential moving-average (EMA)

$$\text{ema}(P_t, \beta) = \beta P_t + (1 - \beta) * \text{ema}(P_{t-1}, \beta)$$

the smoothing coefficient β has the following relation to the number of lagged periods:

$$\beta = 2/(n + 1)$$

- The value of P_0 is usually chosen to be equal to the $sma(P_t, n)$ for a short initial period.
- Typical ratio L/S reported in literature is around $4 \sim 20$.

- Several adaptive moving-average strategies have also been proposed to account for the potentially non-stationary nature of price dynamics (Kaufman 2005).

Example

Moving-Average Example

- Using sma(50) and sma(200), do you see buy or sell signal for Altria stock?

Channel Breakouts

A channel (or band) is an area that surrounds a trend line within which price movement does not indicate formation of a new trend. The upper and bottom walls of channels have a sense of *resistance* and *support*. Trading strategies based on the channel breakouts are popular among practitioners and in academia (Park & Irwin 2007).

- One way to formulate the trading rules with channel breakouts is as follows (Taylor 2005). If a trader has long position at time t, the sell signal is generated when

$$P_t < (1 - B)m_{t-1} \tag{1}$$

where, B is the channel bandwidth and the values of m_t and M_t are defined as

$$M_k = \max(P_{k-1}, ..., P_{k-n}), m_k = \min(P_{k-1}, ..., P_{k-n}) \tag{2}$$

Channel Breakouts

- If a trader has a short position at time t, a buy signal is generated when

$$P_t > (1 + B)M_{t-1} \tag{3}$$

- Finally, if a trader is neutral at time t, the previous conditions are signals for acquiring short and long positions, respectively.
- A more risky strategy may use a buy signal when

$$P_t > (1 + B)m_{t-1},$$

and sell signal when

$$P_t < (1 - B)M_{t-1}$$

- *Bollinger Bands:* the trend line is defined with the price SMA (or EMA), and the bandwidth is determined by the asset volatility

$$B_t = k * \text{stdev}(P_t, L) \tag{4}$$

Example

Channel Breakouts Example

- The trend channel in Altria Group (NYSE:MO) stock can trace its roots all the way back to early 2009. Since that time, the stock has been moving back and forth within the channel, but broke out on June 29.

Momentum and Oscillator Strategies

The term *momentum* is used for describing the rate of price change. In particular, K-day momentum at day t equals:

$$M_t > P_t - P_{t-K} \tag{5}$$

- Momentum smooths price and can be used either for generating trading signals or as trend indicator. For example, a simple momentum rule may be a buy/sell signal when momentum switches from a negative/positive value to a positive/negative one.
- Sometimes, momentum is referred to as the difference between current price and its moving average (e.g. EMA).

$$m_t > P_t - \text{ema}(P_t, K) \tag{6}$$

which leads to further price smoothing.

Momentum and Oscillator Strategies

- Moving Average Convergence/Divergence (MACD) is a momentum indicator, and is calculated as the difference between a fast (12 days) EMA and a slow (26 days) EMA.

$$MACD_t = \text{ema}(P_t, 12) - \text{ema}(P_t, 26) \tag{7}$$

- Its exponential smoothing (performed usually over nine days) is called the signal line:

$$\text{signal\_line} = \text{ema}(MACD_t, 9) \tag{8}$$

Since the signal line evolves slower than the MACD line, their crossovers can be interpreted as trading signals. Namely, buying opportunity appears when MACD line crosses from below to above the signal line, and crossing the signal lines by the MACD line from above can be interpreted as a selling signal.

Example

Moving Average Convergence/Divergence (MACD)

- When the MACD falls below the signal line, it is a bearish signal, which indicates that it may be time to sell. Conversely, when the MACD rises above the signal line, the indicator gives a bullish signal, which suggests that the price of the asset is likely to experience upward momentum.

Momentum and Oscillator Strategies

- Relative Strength Index (RSI) is determined with directional price moves during a given time period N (usually N=14 days).

$$RSI_N = 100 * RS/(1 + RS), RS = n_{\text{up}}/n_{\text{down}} \quad (9)$$

n_{up} and n_{down} are the numbers of upward moves and downward moves of closing price, respectively.

- Usually, these numbers are exponentially smoothed:

$$n_{\text{up}}(t) = (1 - \beta) * n_{\text{up}}(t - 1) + \beta U(t),$$
$$n_{\text{down}}(t) = (1 - \beta) * n_{\text{down}}(t - 1) + \beta D(t),$$

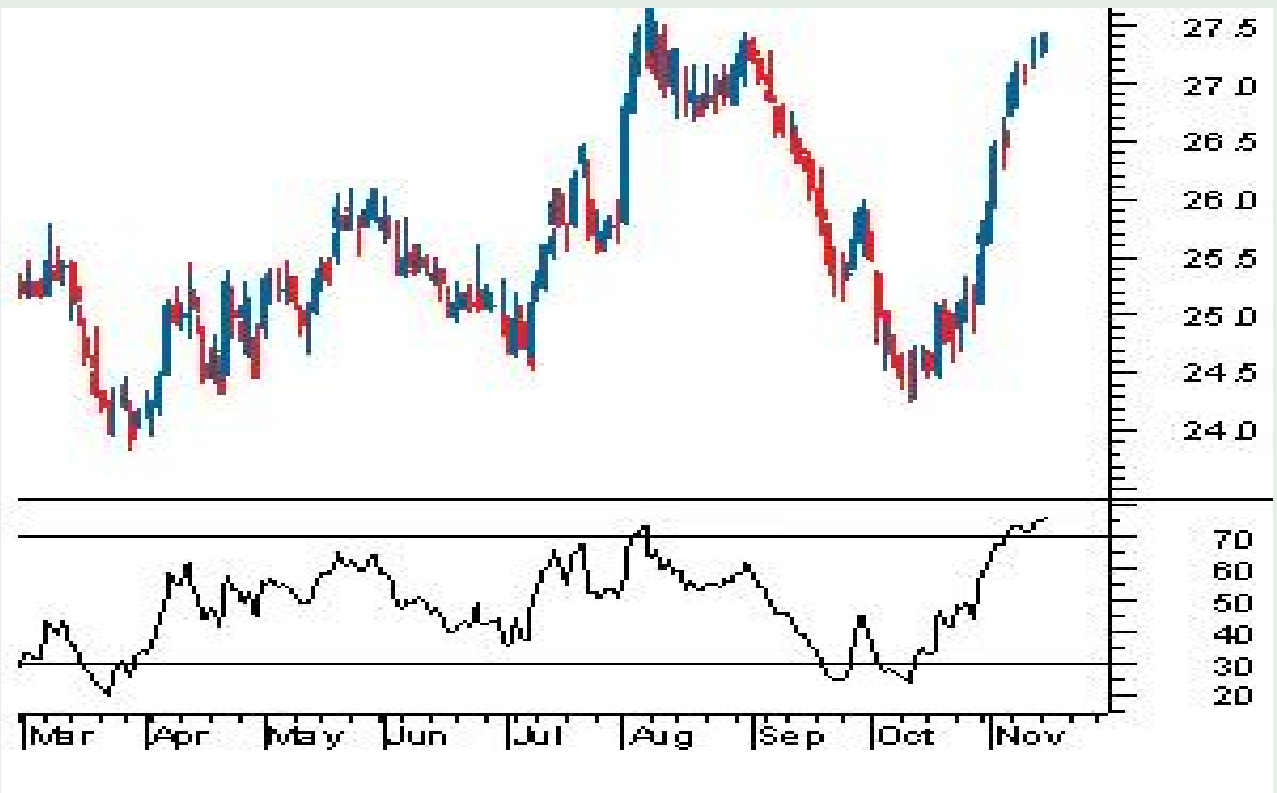
where

$$U(t) = 1, P_t > P_{t-1}; U(t) = 0, P_t \leq P_{t-1}$$
$$D(t) = 1, P_{t-1} > P_t; D(t) = 0, P_{t-1} \leq P_t$$

Example

Relative Strength Index (RSI)

- An asset is deemed to be overbought once the RSI approaches the 70 level, meaning that it may be getting overvalued and is a good candidate for a pullback. Likewise, if the RSI approaches 30, it is an indication that the asset may be getting oversold and therefore likely to become undervalued.



Complex Geometric Patterns

- Trends and oscillators have relatively simple visual forms and straightforward definition. However, some other popular TA patterns, while being easily recognizable with a human eye, represent a challenge for quantitative description. These include head-and-shoulder (HaS), inverse HaS, broadening tops and bottoms, triangle tops and bottoms , double tops and bottoms, and others (Edwards & Magee 2001; Kaufman 2005).
- The main challenge in finding complex geometric patterns in a time series is filtering out noise that may produce false leads.
- The smoothing technique with kernel regression was successfully used for analysis of TA strategies by Lo et al. (2000) in equities and by Omrane & Oppens (2004) in FX.
- The "head-and-shoulders" pattern is believed to be one of the most reliable trend-reversal patterns.

Head-and-Shoulders (HaS) Pattern

- HaS is determined by five price extremes: three maxima that refer to two shoulders surrounding the head, and two valleys between the shoulders and the head:

Head-and-Shoulders (HaS) Pattern

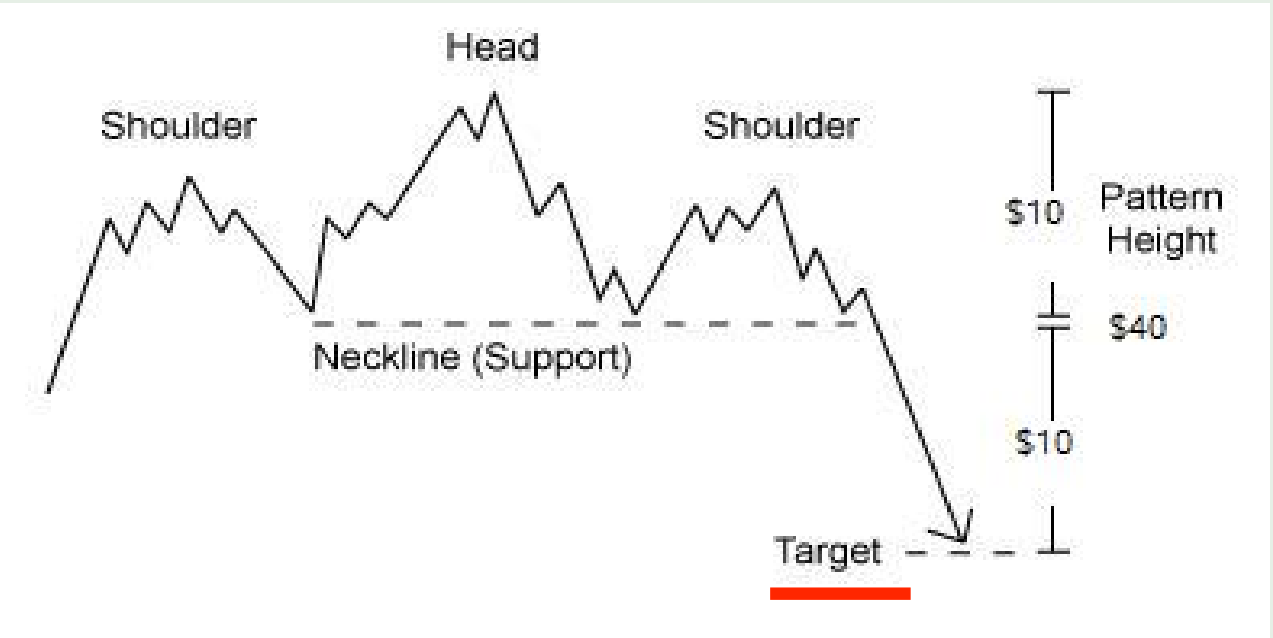
- HaS has a neckline - support line connecting the shoulder minima. The trading idea based on HaS is a selling signal when price breaks through the neckline from above. Inverse HaS is a mirror image of HaS in respect to the time axis. This pattern generates a buy signal when price breaks through the neckline from below.
- Lo et al. (2000) have a relatively simple definition of HaS. Namely, HaS is determined by five consecutive extremes: E1, E2, E3, E4 and E5, such that

  E1 is a maximum; $E3 > E1; E3 > E5$
  E1 and E5 are within 1.5 percent of their average
  E2 and E4 are within 1.5 percent of their average

- Many TA experts emphasize that the trading models should not be over-fitted (e.g. Kaufman 2005; Kerstner 2003; Lo et al. 2000)

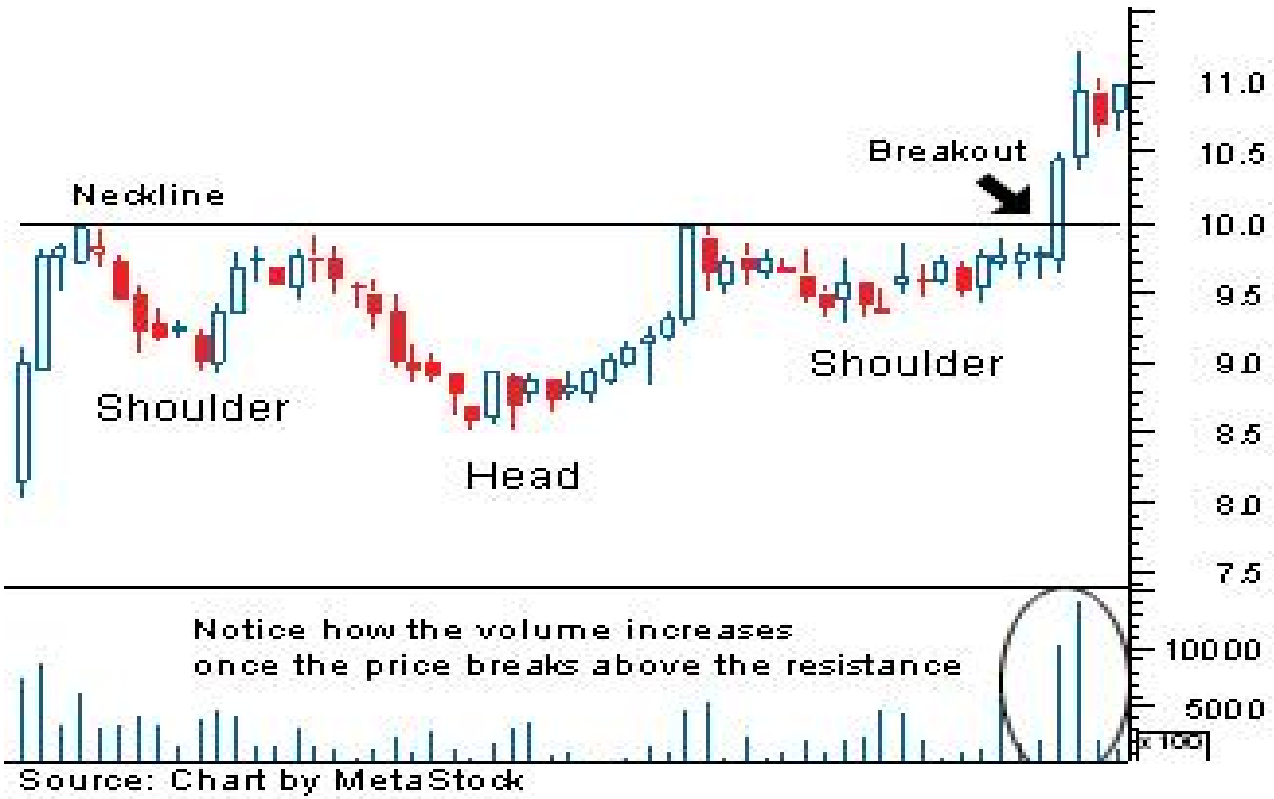
Example

- This is measured based on the height of the chart pattern, which is essentially the distance in price between the peak of the head and the neckline. For example, let's say that in a head-and-shoulders top, the peak of the head is formed at $50 and the neckline was established at $40 - a difference of $10.
- The price objective is calculated by subtracting the price at which the pattern breaks the neckline ($40) by the difference between the head and the neckline ($10). Based on this example, the price objective is $30 ($40-$10).



Head-and-Shoulders (HaS) Pattern

- The inverse head-and-shoulders pattern is the exact opposite of the head-and-shoulders top, as it signals that the security is set to make an upward move. The inverse head and shoulders is considered to be a reversal pattern, as the security typically heads higher after the pattern.



Human Brain for Complex Patterns

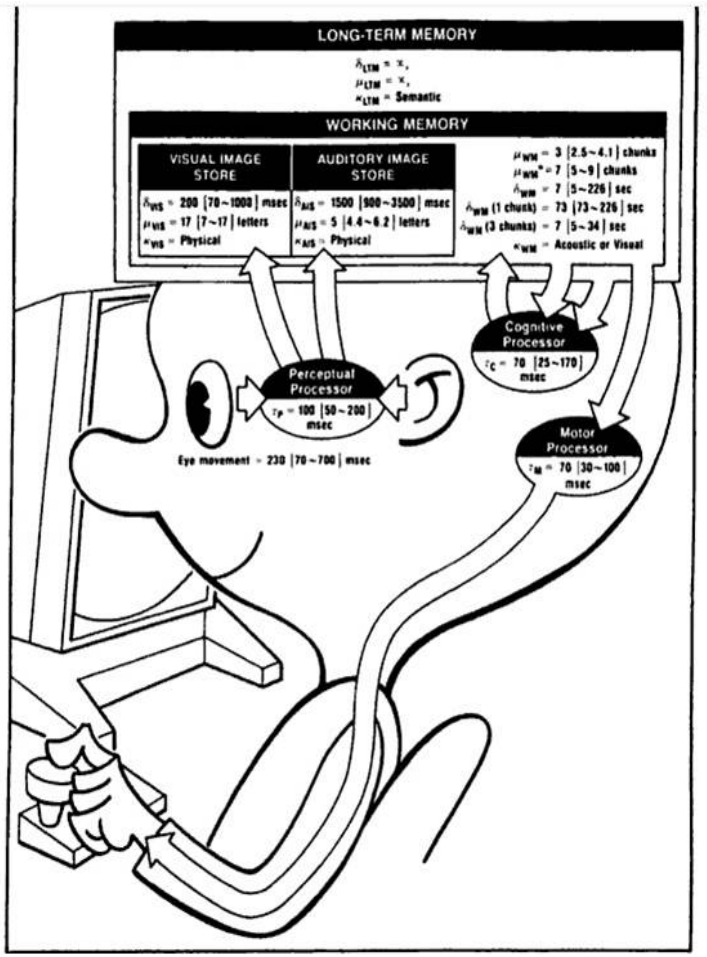
Three processors and several types of memory: Perceptual Processor t_p, Cognitive Processor t_c, and Motor Processor t_m.

$$t_{total} = t_p + t_c + t_m,$$

where $t_p \sim 100[50, 200]ms$

$$t_c \sim 70[25, 170]ms$$

$$t_m \sim 70[30, 100]ms.$$



Information Theory to Describe the Speed of Movements:

- **Reaction Time:** the time from onset of a signal calling for response until beginning of response (typically 100-250)
- **Hick-Hayman Law:** the more choices of given kinds you have, the longer it takes you to come to a decision. ms, Raskin uses 250 ms as back of envolope).

$$AT = RT + MT, \text{(for the speed of movements)}$$

where AT - action time

RT - reaction time

MT - movement time

- **Pros and Cons:**

\+ Humans recognize/anticipate complex patterns better & faster

\+ Market gyrations that HFTs are using are small, so computers would not have as much time to gather the needed data

\- Humans cannot maintain constant productivity

\- Some form of automation to assist human trading