

Glossary

Adaptability The ability of computing systems (neural or otherwise) to adapt themselves to the data. Such an ability is synonymous to learning.

Adaptive fuzzy system A fuzzy system that forms its rules from data, or where a human expert does not tell the system what the rules are. Fuzzy rules are extracted from data feeds. An adaptive fuzzy system acts as a human expert in real time.

Adaptive resonance theory An unsupervised neural network paradigm which addresses issues in the stable self organization or clustering of patterns.

Advance/Decline line Widely-used indicators to measure the breadth of a stock market advance or decline. Each day (or week) the number of advancing issues is compared to the number of declining issues. If advances outnumber declines, the net total is added to the previous cumulative total. If declines outnumber advances, the net difference is subtracted from the previous cumulative total. The advance/decline line is usually compared to a popular stock average. They should trend in the same direction. When the advance/decline line begins to diverge from the stock average, an early indication is given of a possible trend reversal.

Anti-persistence A reversal of a time series, occurring more often than reversal would occur in a random series. If the system has been up in the previous period, it is likely to be down in the next period, and vice versa.

Arms index Also called Trin, this indicator is the average volume of declining stocks divided by the average volume of advancing stocks. A reading below 1.0 indicates more volume in rising stocks. A reading above 1.0 reflects more volume in declining issues. However, an extreme high reading suggests an oversold market and an extreme low reading, and overbought market.

Artificial intelligence (AI) AI views the mind as a type of logical symbol processor that works with strings of text or symbols much as a computer works with strings of 0s and 1s. In practice, AI means expert systems or decision trees.

Ascending triangle A sideways price pattern between two converging trendlines, in which the lower line is rising while the upper line is flat. This is generally a bullish pattern.

Attractor In a non-linear dynamic series, a point of stability. See also *Limit cycle*, *Point attractor*, or *Strange attractor*.

Autoassociative Memory A memory which is designed to transform an input pattern to itself. If the input pattern is noisy, degraded or incomplete the memory will still recall the original or learnt pattern.

Back Propagation A learning scheme by which a multi-layer network is organized for pattern recognition or classification utilizing an external teacher, and error feedback (or propagation).

BDS statistics Brock-Dechert-Scheinkman test for serial independence in a time series.

Beta is the standardized covariance of an instrument with its complete class of similar instruments. That is, the overall movement relative to its market.

Breakaway gap A price gap that forms on the completion of an important price pattern. A breakaway gap usually signals the beginning of an important price move.

Bullish consensus Weekly numbers based on a poll of newsletter writers published by Hadady Publications in Pasadena, California. When 80% of newsletter writers are bullish on a market, that market is considered to be overbought and vulnerable to a price decline. Readings below 30 percent are indicative of an oversold market and are considered bullish.

Capital Asset Pricing Model (CAPM) An equilibrium-based asset pricing model developed independently by Sharpe, Linter, and Mossin. The simplest version states that assets are priced according to their relationship to the market portfolio of all risky assets, as determined by the securities' beta.

Channel line Straight lines drawn parallel to the basic trendline. In an uptrend, the channel line slants up to the right and is drawn above rally peaks; in a downtrend, the channel line is drawn down to the right below price troughs. Prices will often meet resistance at rising channel lines and support at falling channel lines.

Chaos A deterministic, nonlinear dynamic system that can produce random-looking results. An aperiodic equilibrium state of a dynamical system. A system in a chaotic equilibrium seems to wander "at random" through states. Yet the behavior is deterministic: A math equation describes it exactly. If you know the equation, you can predict any point of the chaotic path or trajectory. Chaos has the property that if you pick any two starting points of a chaotic system, no matter how close, they give rise to two paths that will diverge in time. Most dynamical systems have chaotic equilibria. These range from the interaction of subatomic particles to the flutter of the olfactory bulb in your nose to the bubbles in a hot tub and from the swirl of clouds in the sky to the distribution of galaxies in space. A chaotic system must have a fractal dimension and must exhibit sensitive dependence on initial conditions. See *Fractal*, *Lyapunov exponent*, and *Strange attractor*.

Character recognition The process of visually interpreting characters or letters. This is a classically hard problem to solve due to different fonts, handwritten symbols, noise etc.

Coherent Market Hypothesis A theory stating that the market distribution may be determined by a combination of group sentiment and fundamental bias. Depending on combinations of these two factors, the market can be in one of four states: random walk, unstable transition, chaos, or coherence.

Competitive Learning A learning rule where processing elements compete to respond to a given input stimulus. The winner then adapts to make itself more like the input.

Confirmation Having as many technical factors as possible agreeing with one another. For example, if prices and volume are rising together, volume is confirming the price action. The opposite of confirmation is divergence.

Continuation patterns Price formations that imply a pause or consolidation in the prevailing trend, after which the prior trend is resumed. The most common types are triangles, flags and pennants.

Control Strategy Specifies the order in which network weights are updated for digital implementations of learning functions.

Correlation dimension An estimate of the fractal dimension that (1) measures the probability that two points chosen at random will be within a certain distance of each other and (2) examines how this probability changes as the distance is increased. A dependent system will be held together by its correlations and will retain its dimension in whatever embedding dimension it is placed, as long as the embedding dimension is greater than its fractal dimension. White noise will fill its space because its components are uncorrelated, and its correlation dimension is equal to whatever dimension it is placed in.

Correlation integral The probability that two points are within a certain distance from one another is given by the sum or integral over fixed size boxes in state space; used in the calculation of the correlation dimension.

Crossover A procedure or operator in Genetic Algorithms used to introduce diversity during reproduction. One-point crossover takes two child chromosomes, selects at random one point on those children, and swaps the genetic material on the children at that point. Two-point crossover works the same but selects two points at random. The use of crossover is a very important feature of the genetic algorithm, and may be critical to its success.

Delta rule learning A type of learning where weights are modified to reduce the difference between the desired output and the actual output of a processing element. Synonymous for Widrow-Hoff learning. Realizes the minimization of mean squared error.

Descending Triangle A sideways price pattern between two converging trendlines, in which the upper line is declining while the lower line is flat. This is generally a bearish pattern.

Divergence A situation where two indicators are not confirming each other. For example, in oscillator analysis, prices trend higher while an oscillator starts to drop. Divergence usually warns of a trend reversal.

Double top This price pattern displays two prominent peaks. The reversal is complete when the middle trough is broken. The double bottom is a mirror image of the top.

Down trendline A straight line drawn down and to the right above successive rally peaks in a downtrend. A violation of the down trendline usually signals a change in the trend.

Dynamic System A system that changes with time. A simple version of a dynamic system is a set of linear simultaneous equations. Nonlinear simultaneous equations

are nonlinear dynamic systems. In math a system described by a first-order differential or difference equation -- a system whose change is some function of time or of system parameters. In a broad sense everything is a dynamical system, the universe and all its pieces. The starting point of a dynamical system is an initial condition. The final point or points is the equilibrium state. In between lie the transient states. A dynamical system can have two types of equilibrium states: periodic and aperiodic. Aperiodic equilibria are *chaotic* attractors. Once the system falls in one of these regions it moves around forever, or until something bumps it into a new state, with no apparent structure or periodicity to the movement. The simplest periodic equilibrium is the fixed point attractor. There are also *limit cycle* attractors, where the state swirls round and round in equilibrium, and strange attractors. See also *Point attractor*, *Limit cycle*, and *Strange attractor*.

Efficient frontier In mean/variance analysis, the curve formed by the set of efficient portfolios -- that is, those portfolios of risky assets that have the highest level of expected return for their level of risk.

Efficient Market Hypothesis (EMH) A theory that states, in its semistrong form, that, because current prices reflect all public information, it is impossible for one market participant to have an advantage over another and reap excess profits.

Euclidean geometry Plane or "high school" geometry, based on a few ideal, smooth, symmetric shapes.

Exhaustion Gap A price gap that occurs at the end of an important trend and signals that the trend is ending.

Expert system A computer system that tries to simulate a human expert. A search tree and method of traversal in artificial intelligence. The expert provides her knowledge as if-then rules and a programmer codes these in software. Expert systems define a large logic tree or several small trees. The expert system has two pieces: the knowledge base and the inference engine. The knowledge base is just the tree or trees of bivalent rules. The inference engine is some scheme for reasoning or "chaining" the rules. Fuzzy systems are a type of expert system since they too store knowledge as rules -- but as fuzzy rules or fuzzy patches. Expert systems work with black-white logic and symbols. Fuzzy systems work with fuzzy sets and have a numerical or math basis that permits both math analysis and simple chip design.

Exponential smoothing A moving average that uses all data points, but gives greater weight to more recent price data.

Fault tolerance A property of neural computing systems that allows the system to function and gradually degrade when a small number of processing elements are destroyed or disabled (see Graceful degradation).

Feedforward network A network in which information flow is all in one direction. In such networks there are no feedback loops from a processing element to a previous one.

Fractal An object in which the parts are in some way related to the whole; that is, the individual components are "self-similar at all magnifications." An example is the branching network in a tree. Each branch and each successive smaller branching is different but all are qualitatively similar to the structure of the whole tree.

Fractal dimension A classical way of describing a fractal dimension relates to measuring the length of a "wiggly" line with various different measuring sticks. For example, the coastline of Britain (like that of many other countries) is a wiggly line. The length of a coastline can be measured by counting how many times one can fit a measuring stick with a known length along the coastline and multiplying this number with the length of the measuring stick. While this seems to be a very obvious way it appears that the length of a "wiggly line" depends on the length of the measuring stick.

Fractal distribution A probability density function that is statistically self-similar. That is, in different increments of time, the statistical characteristics remain the same.

Fractal Market Analysis A method to measure the memory in a time series, the fractal dimension and/or correlation dimension in time series. See *Rescaled Range Analysis, fractal dimension* and *correlation dimension*

Fractional brownian motion A biased random walk; comparable to shooting craps with loaded dice. Unlike standard brownian motion, the odds are biased in one direction or the other.

Fuzzy logic Has two meanings. The first meaning is multivalued or "vague" logic. Everything is a matter of degree including truth and set membership. The second meaning is reasoning with fuzzy sets or with sets of fuzzy rules. This dates back to the first work on fuzzy sets in the 1960s and 1970s by Lotfi Zadeh at the University of California at Berkeley. Zadeh chose the adjective "fuzzy" over the traditional adjective "vague" in his 1965 paper "Fuzzy Sets" and the name has stuck. Other synonyms: ray logic, cloudy logic, continuous logic.

Fuzzy rule A conditional of the form IF X IS A, THEN Y IS B where A and B are fuzzy sets... In math terms a rule is a relation between fuzzy sets. Each rule defines a fuzzy patch (the product $A \times B$) in the system "state space". The wider the fuzzy sets A and B, the wider and more uncertain the fuzzy patch. Fuzzy rules are the knowledge building blocks in a fuzzy system. In math terms each fuzzy rule acts as an associative memory that associates the fuzzy response B with the fuzzy stimulus A .

Fuzzy set A set whose members belong to it to some degree. In contrast a standard or nonfuzzy set contains its members all or none. The set of even numbers has no fuzzy members. Unlike nonfuzzy sets, in fuzzy sets their numbers belong to them to some degree.

Fuzzy system A set of fuzzy rules that converts inputs to outputs. In the simplest case an expert states the rules words or symbols. In the more complex case a neural system learns the rules from data or from watching the behavior of human experts. Each input to the fuzzy system fires all the rules to some degree as in a massive associative memory. The closer the input matches the if-part of a fuzzy rule, the more the then-part fires. The fuzzy system adds up all these output or then-part sets and takes their average or centroid value. The centroid is the output of the fuzzy system. Fuzzy chips perform this associative mapping from input to output thousands or millions of times per second. Each map from input to output defines one FLIPS -- or fuzzy logical inferences per second. The Fuzzy Approximation Theorem (FAT) show that a fuzzy system can model any continuous system. Each rule of the fuzzy system acts as a fuzzy patch that the system places so as to resemble the response of the continuous system to all possible inputs.

Gaussian A system whose probabilities are well described by a normal distribution, or a bell-shaped curve.

Generalization The ability of a neural computing system to generalize from the input/output examples it was trained on to produce a sensible output to a previously unseen input. Compromise of the variance-bias dilemma.

Genetic algorithm Genetic algorithms (GAs) are problem-solving techniques that solve problems by evolving solutions as nature does, rather than by looking for solutions in a more principled way. Genetic algorithms, sometimes hybridized with other optimization algorithms, are the best optimization algorithm available across a wide range of problem types.

Graceful Degradation The ability of a neural computing system to only slowly cease to function properly if a small number of processing elements are destroyed or disabled (see Fault Tolerance).

Hausdorff dimension A different type of topological dimension which has the interesting characteristic that it can also take non-integer values. The Hausdorff dimension can be approximated by the fractal dimension or correlation dimension.

Head and shoulders The best known of the reversal price patterns. At a market top, three prominent peaks are formed with the middle peak (or head) slightly higher than the two other peaks (shoulders). When the trendline (neckline) connecting the two intervening troughs is broken, the pattern is complete. A bottom pattern is a mirror image of a top and is called an inverse head and shoulders.

Hidden neuron is a usually non-linear (or linear) processing element with no direct connections to either inputs or outputs. It often provides the learning capacity of the neural network.

Hurst exponent (H) A measure of the bias in fractional brownian motion. $H = 0.50$ for brownian motion; $0.5 < H < 1.0$ for persistent or trend-reinforcing series; $0 < H < 0.5$ for an antipersistent or mean-reverting system. The inverse of the Hurst exponent is equal to alpha, the characteristic exponent for fractal or Pareto distributions.

Image (data) compression The process of converting an image into a representation that uses a smaller number of bytes (memory space) so that information can be encoded and stored more efficiently.

Key reversal day In an uptrend, this one-day pattern occurs when prices open in new highs and then close below the previous day's closing price. In a downtrend, prices open lower and then close higher. The wider the price range on the key reversal day and the heavier the volume, the greater the odds that a reversal is taking place.

Layer The main architectural component of a neural network consisting of a number of processing elements of equal functionality and occupying a position in the network corresponding to a particular stage of processing.

Learning schedule A schedule which specifies how parameters associated with learning change over the course of training a network.

Learning Self-adaptation at the processing element level. Weighted connections between processing elements or weights are adjusted to achieve specific results, eliminating the need for writing a specific algorithm for each problem

Leptokurtosis The condition that a probability density curve has fatter tails and a higher peak at the mean than the normal distribution.

Limit cycle An attractor (for nonlinear dynamic systems) that has periodic cycles or orbits in phase space. An example is an undamped pendulum, which will have a closed-circle orbit equal to the amplitude of the pendulum's swing. See *Attractor, Phase space*.

Lyapunov exponent A measure of the dynamics of an attractor. Each dimension has a Lyapunov exponent. A positive exponent measures sensitive dependence on initial conditions, or how much a forecast can diverge, based on different estimates of starting conditions. In another view, a Lyapunov exponent is the loss of predictive ability as one looks forward in time. Strange attractors are characterized by exhibiting at least one positive exponent. A negative exponent measures how points converge toward one another. Point attractors are characterized by all negative variables. See *Attractor, Limit cycle, Point attractor, and Strange Attractor*.

Mechanical trading system A mechanical trading approach is one which (i) has a predetermined group of securities or markets that are followed; (ii) mathematical formulas are applied to prices that then tell when to buy and when to sell; (iii) there are entry rules, exit rules for profitable and losing trades; (iv) there are rules for when to start trading and stop trading. The user of a mechanical trading system chooses a system and markets to trade and applies the system rules to market price action. If the system is computerized, data needs to be provided to the computer, to run the system, and place the orders the system dictates. The key to creating a successful mechanical system is to avoid creating a curve-fitting system. A mechanical trading approach avoids the destructive emotionalism that permeates discretionary trading.

Membership function is a function that represents the possibility of belonging to a set of crisp values. The membership functions are convex functions, that range between zero and one.

Modern Portfolio Theory (MPT) The blanket name for the quantitative analysis of portfolios of risky assets based on the expected return (or mean expected value) and the risk (or standard deviation) of a portfolio of securities. According to MPT, investors would require a portfolio with the highest expected return for a given level of risk.

Momentum A technique used to construct an overbought/oversold oscillator. Momentum measures price differences over a selected span of time. To construct a 10-day momentum line, the closing price 10 days earlier is subtracted from the latest price. The resulting positive or negative value is plotted above or below a zero line.

Moving Average A trend-following indicator that works best in a trending environment. Moving averages smooth out price action but operate with a time lag. Any number of moving averages can be employed, with different time spans, to generate buy and sell signals. When only one average is employed, a buy signal is given when the price closes above the average. When two averages are employed, a

buy signal is given when the shorter average crosses above the longer average. Technicians use three types: simple, weighted, and exponentially smoothed averages.

Mutation Mutation is an operator in Genetic Algorithm. It introduces diversity during reproduction. At a very low level of probability, binary mutation replaces bits on a chromosome with randomly-generated bits. This probability is a parameter of genetic algorithm.

Network A mathematical model of a computing system.

Neural computing A fast growing field of computing technology inspired by studies of the brain. Neural computing, from its origins, is ideally adapted to doing pattern matching, pattern recognition, and control function synthesis.

Neural network A system that maps inputs to outputs. Also called a neurocomputer. A neural network is a nonlinear dynamical system. Its equilibrium states can recall or recognize a stored pattern or can solve a mathematical or computational problem.

Neural net trading system A neural net trading system is an automated way of trading a financial security or financial market based on neural network technology. A neural net trading system can be used as decision-support or decision-making system.

Neuron A nerve cell in the physiological nervous system.

Nonlinearity Refers to a mapping which is nonlinear or in which the input is not a multiple of the output. A nonlinear network can be achieved by using nonlinear transfer functions, by competition among neurons, or by normalization.

Open interest The number of options or futures contracts that are still unliquidated at the end of a trading day. A rise or fall in open interest show that money is flowing into or out of a futures contract or option, respectively. Open interest also measures liquidity.

Order parameter In a nonlinear dynamic system, a variable that summarizes the individual variables that can affect a system. For example, the Dow Jones is an order parameter, because it summarizes the change of some thirty stocks.

Oscillators Technical indicators that are utilized to determine when a market is in an overbought and oversold condition. Oscillators are plotted at the bottom of a price chart. When the oscillator reaches an upper extreme, the market is oversold. Two types of oscillators use momentum and rates of change.

Overbought A term usually used in reference to an oscillator. When an oscillator reaches an upper extreme, it is believed that a market has risen too far and is vulnerable to a selloff.

Oversold A term usually used in reference to an oscillator. When an oscillator reaches a lower extreme, it is believed that market has dropped to far and is due for a bounce.

Parallel Processing A form of computing in which many computations are being processed simultaneously. One of the unique features of neural computing is that it

provides an inherently clean and simple mechanism for dividing the computational task into subunits. This inherent parallelism makes it an ideal candidate for a highly parallel architectures.

Pattern Recognition The categorization of patterns in some domain into meaningful classes. A pattern usually has the form of a vector of measurement values.

Pennant This continuation price pattern is similar to the flag, except that it is more horizontal and resembles a small symmetrical triangle. Like the flag, the pennant usually lasts from one to three weeks and is typically followed by a resumption of the prior trend.

Persistence A tendency of a series to follow trends. If the system has increased in the previous period, the chances are that it will continue to increase in the next period. Persistent time series have a long memory; long-term correlation exists between current events and future events. See *Antipersistence*, *Hurst exponent*, and *Rescaled range (R/S) analysis*.

Phase Space A graph that shows all possible states of a system. In phase space, the value of a variable is plotted against possible values of the other variables at the same time. If a system has three descriptive variables, the phase space is plotted in three dimensions, with each variable taking one dimension.

Point attractor In nonlinear dynamics, an attractor where all orbits in phase space are drawn to one point or value. Essentially, any system that tends to a stable, single-valued equilibrium will have a point attractor. A pendulum damped by friction will always stop. Its phase space will always be drawn to the point where velocity and position are equal to zero. See *Attractor*, *Phase space*.

Price patterns Patterns that appear on price charts that have predictive value. Patterns are divided into reversal patterns and continuation patterns.

Processing element The neuron-like unit that, together with many other processing elements, forms a neural computing network. Computational abstraction of a neuron.

Put/Call ratio The ratio of volume in put options divided by the volume of call options is used as a contrary indicator. When put buying gets too high relative to call buying (a high put/call ratio), the market is oversold. A low put/call ratio represents an overbought market condition.

Random walk Brownian motion, where the previous change in the value of a variable is unrelated to future or past changes. See *White Noise*.

Rate of change A technique used to construct an overbought/oversold oscillator. Rate of change employs a price ratio over a selected span of time. To construct a ten-day rate of change oscillator, the last closing price is divided by the close price ten days earlier. The resulting value is plotted above or below a value of 100.

Ratio analysis The use of a ratio to compare the relative strength between two entities. An individual stock or industry group divided by the S&P 500 index can determine whether that stock or industry group is outperforming or underperforming the stock market as a whole. Ratio analysis can be used to compare

any two entities. A rising ratio indicates that the numerator in the ratio is outperforming the denominator. Ratio analysis can also be used to compare market sectors such as the bond market to the stock market or commodities to bonds. Technical analysis can be applied to the ratio line itself to determine important turning points.

Recall schedule A schedule which specifies how parameters associated with the response of a network change over the course of recall.

Relative-Strength Index (RSI) A popular oscillator developed by Welles Wilder, Jr., and described in his 1978 book, *New Concepts in Technical Trading Systems*. RSI is plotted on a vertical from 0 to 100. Values above 75 are considered to be overbought and values below 25 are considered to be oversold. When prices are over 75 or below 25 and diverge from price action, a warning is given of a possible trend reversal. RSI usually employs time spans of 9 or 14 days.

Reproduction A procedure applied in Genetic Algorithms whereby problem solutions or parents are selected from a population of problem solutions using a random selection procedure. Each parent's selection chances are biased so that the parents with the highest evaluations are most likely to reproduce. Children are made by copying the parents, and the parents are returned to the population.

Rescaled range (R/S) analysis The method developed by H.E. Hurst to determine long-memory effects and fractional brownian motion. A measurement of how the distance covered by a particle increases over longer and longer time scales. For brownian motion, the distance covered increases with the square root of time. A series that increases at a different rate is not random. See *Antipersistence, Fractional brownian motion, Hurst exponent, and Persistence*.

Resistance The opposite of support. Resistance is marked by a previous price peak and provides enough of a barrier above the market to halt a price advance.

Retracements Prices normally retrace the prior trend by a percentage amount before resuming the original trend. The best known example is the 50 percent retracement. Minimum and maximum retracements are normally one-third and two-thirds, respectively. Elliot Wave Theory uses Fibonacci retracements of 38 percent and 62 percent.

Reversal Patterns Price patterns on a price chart that usually indicate that a trend reversal is taking place. The best known of the reversal patterns are the *head and shoulders* and *double* and *triple* tops and bottoms.

Roulette Wheel Parent Selection A technique to determine which problem solutions or population members are chosen for reproduction. Using this technique, each chromosome's evaluation is proportional to the size of its slice on a roulette wheel. Selection of parents to reproduce is carried out through successive spins of the roulette wheel spinner. After a spin, the chromosome chosen is the one in whose slice the arrow ends up. See also *Genetic Algorithm*

Self-organization The adaptation of the weights in a neural network in response to a learning stimulus. Usually this is unsupervised.

Sentiment indicators Psychological indicators that attempt to measure the degree of bullishness or bearishness in the stock market or in individual markets.

These are contrary indicators and are used in much the same fashion as overbought or oversold oscillators. Their greatest value is when they reach upper or lower extremes.

Set theory The study of sets or classes of objects. The set is the basic unit in math just as the symbol is the basic unit in logic. Logic and set theory make up the foundations of math. In theory all the symbols of advanced calculus and nuclear physics are just shorthand for the longhand of sets and logic. Classical set theory does not acknowledge the fuzzy or multivalued set whose members belong to the set to some degree. Classical set theory is bivalent. Each set contains all members all or none.

Simple average A moving average that gives equal weight to each day's price data.

Simulated Annealing A technique used to search for global minima in an energy surface in which states are updated based on a statistical rule rather than deterministically; this update rule changes to become more deterministic as the search progresses.

Speech recognition The decoding of a sound pattern into phonemes or words.

Stochastics An overbought/oversold oscillator that is based on the principle that as prices advance, the closing price moves to the upper end of its range. In a downtrend, closing prices usually appear near the bottom of their recent range. Time periods of 9 and 14 days are usually employed in its construction. Stochastics uses two lines -%K and its 2-day average, %D. These two lines fluctuate in a vertical range between 0 and 100. Readings above 80 are overbought, while readings below 20 are oversold. When the faster %K crosses below the %D line and the lines are over 80, a sell signal is given. There are two stochastics versions: fast stochastics and slow stochastics. Most traders use the slower version because of its smoother look and more reliable signals.

Strange attractor An attractor in phase space, where the points never repeat themselves and the orbits never intersect, but both the points and the orbits stay within the same region of phase space. Unlike limit cycles or point attractors, strange attractors are nonperiodic and generally have a fractal dimension. They are a configuration of a nonlinear chaotic system. See *Attractor*, *Chaos*, *Limit cycle*, and *Point attractor*.

Subsethood The degree to which one set contains another set. In classical set theory a set has subsets all or none. In fuzzy logic it is a matter of degree. That means the subsethood or containment value can take any value between 0% and 100%. The measure of subsethood comes from the Subsethood Theorem. The subset theorem gives a new way to view the probability of an event. It equals the whole in the part. The probability of the part or event is the degree to which the whole or the "space" of all events is contained in the part. This relation cannot hold if subsethood is not fuzzy and can take on only the extreme black-white values of 0% and 100%.

Summation Function The part of a processing element that adds the signals that enter the element.

Supervised Learning Learning in which a system is trained by using a teacher to show the system the desired response to an input stimulus, usually in the form of a desired output.

Symmetrical Triangle A sideways price pattern between two converging trendlines in which the upper trendline is declining and lower trendline is rising. This pattern represents an even balance between buyers and sellers, although the prior trend is usually resumed. The breakout through either trendline signals the direction of the price trend.

Threshold A constant which is used as a comparison level by a variable. If the variable has a value above the threshold some action is taken (for example, a neuron fires), and if its value is below the threshold, no action is taken.

Trading system A trading system is an automated way of trading a financial security or financial market. Such a system can be designed on the basis of simple if...then rules, imbedded in a mechanical trading system or on the basis of neural networks, genetic algorithms, fuzzy logic or combinations of these technologies. A trading system can be used as decision-support or decision-making system.

Training Exposing a neural computing system to a set of example stimuli to achieve a particular user-defined goal.

Transfer function The component of a processing element through which the sum is passed (transformed) to create net output. It is usually non-linear.

Trend Refers to the direction of prices. Rising peaks and troughs constitute an uptrend; falling peaks and troughs constitute a downtrend. A trading range is characterized by horizontal peaks and troughs. Trends are generally classified into major (longer than 6 months), intermediate (one to six months), or minor (less than a month).

Trendlines Straight lines drawn on a chart below reaction lows in an uptrend, or above rally peaks in a downtrend, that determine the steepness of the current trend. The breaking of a trendline usually signals a trend change.

Triangles Sideways price patterns in which prices fluctuate within converging trendlines. The three types of triangles are the symmetrical, the ascending, and the descending.

Triple top A price pattern with three prominent peaks, similar to the head and shoulders top, except that all three peaks occur at about the same level. The triple bottom is a mirror image of the top.

Universe of discourse The range over which a variable is defined.

Unsupervised learning Learning in which no teacher is used to show the correct response to a given input stimulus; the system must organize itself purely on the basis of the input stimuli it receives.

Up trendline A straight line drawn upward and to the right below reaction lows in an uptrend. The longer the up trendline has been in effect and the more times it has been tested, the more significant it becomes. Violation of the trendline usually signals that the uptrend may be changing direction.

Weighted Average A moving average that uses a selected time span but gives greater weight to more recent price data.

Weighted connections The channels through which information enters processing elements in a neural computing system, also called interconnects, throughout which memory is distributed.

White noise The audio equivalent of brownian motion; sounds that are unrelated and sound like a hiss. The video equivalent of white noise is "snow" on a television receiver screen.