Glossary(10Jun05)

adjacency matrix: The rows of A =[eij] correspond to the n vertices vi of the unlabeled graph Gn, and the n columns are all the possible neighbors vj. If there is an edge from vi to vj, then eij =1, otherwise eij = 0.

agent: a decision-making entity having specific goals and preferences.

algebra: a formal system for relating and operating on elements of abstract structures, such as number systems or groups.

anigraf: a social network of mental organisms or agents. See Part I, section 4.

atoms: connected graphs associated with the diagonal Ramsay numbers. See sec. 11.4.

automorphism (of G): a one to one mapping f of the vertex set V(G) onto itself with the property that f (v) and f (w) are adjacent if and only if v and w are.

bipartite; K(m,n) is a graph G mn where the vertices can be partitioned into two unconnected subsets such that every edge of G joins vertices in one set with vertices in the other

Borda Count: Preferences are weighted inversely to their rank to determine the voting power of an individual's choices. Thus, if there are three choices, the Borda weight vector will be {3,2,1}. This vector will be applied respectively to the first, second and third choices of each voter, and then these weights will be summed for all voters to give the Borda Count. See Appendix 1.

broker: a high-level mental organism of an anigraf that controls sequences of actions by agents.

causal network: a directed acylic graph that represents the history of the graf's evolution.

centroid: that vertex with the highest degree; but see 10.2.

chain: Cn is a chain if all vertices have degree two, excepting two (ends) which have degree one.

chaos: an irregular and unpredictable sequence of states of a system such that past behaviors are not repeated. Typical examples include non-linear mechanical oscillators, fluids, and some chemical reactions. However, chaos can also occur in social decision-making.

circumference: the length of the longest graph cycle.

clique: a subgroup of an anigraf population with similar goals.

co-evolution: the evolution of different anigraf species whose

development depends critically on the interactions among the species. See Appendix 4 for an example.

Coelenterate: invertebrate animals such as sea anemones, jellyfish, and hydroids.

Cognitive Modes: frameworks for knowledge, thought and especially Reasoning by analogy. More generally, constraints on theories of natural modes. See also Ideonomy.

complement: the complement of Gn has all the remaining edges of the complete graph Kn, and none of the edges of Gn.

conditional probability: p(A/B) : the probability of event A, given that event B has occurred.

Condorcet winner: the alternative (goal, choice) that beats all other alternatives in a pair-wise contest.

coordinate frame: a distinguished point (the origin of the frame) with axes representing the different variables with categories such as numbers assigned to positions along the axes.

covered graph: If at least one vertex is adjacent to all the remaining vertices, the graph will be covered. Covered graphs will always have a Condorcet winner.

cutpoint: a vertex is a cutpoint of a connected graph if the removal of this vertex creates a disconnected graph. If the removal of an edge creates a disconnected graph, the edge is called a *bridge*.

cybernetics: from the Greek work "steersman". The field of (feedback) control and communication theory, whether in the machine or in the animal (N. Weiner, 1948.)

cycle, graph: an alternating sequence of n>=3 distinct vertices and distinct edges linking these vertices with the last member of the vertex sequence also being the first, thus creating a closed path.

cycle, social: given at least three alternatives, a sequence of winners in a pairwise (Condorcet) contest such that the last member of the sequence beats the first. See top-cycle.

daemon: a mental organism.

dance: typically, a sequence of movements, such as gaits, executed in coordination by two physically distinct entities. However, can be generalized to include the interplay between two mental organisms.

degree: the number of edges incident with a vertex.

diameter: the longest length of the shortest path between any two vertices in a graph.

digraph: Dn is a graph G with directed edges between vertices.

dimensional analysis: a method that utilizes the dimensions of variables
used to describe natural phenomena in order to recover the form
of the underlying model. Assumes that the phenomenon can be
described by a dimensionally correct equation among the
particular variables. Dimensionless products of variables and
linear algebra play a key role.

directed graph: see digraph.

dispersion game: a game with an outcome that maximally disperses
agents over a set of possible actions. Useful for optimizing the
roles of players on team, where actions and talents of the players
differ.

domain map: see knowledge structure.

dynamical system: a smooth transformation of variables that
characterizes the evolution of the state of the system. For
example, $x_{n+1} = f(x_n)$.

eccentricity (of a vertex): the longest length of the shortest path from
the chosen vertex to any other.

Euglena: a one-celled organism up to .01 inch long with a "tail"
(flagellum) that whips to provide locomotion. Often found on the
surface of ponds, where chlorophyll used for photosynthesis gives
the organism a greenish color.

fixed point: the terminal point of an iterated function or map. For
Anigrafs, also an equilibrium or stable point.

Flagellum: a long, thin fiber that moves like a whip to propel an
organism.

frame: see coordinate frame

free agent: mental organisms whose preferences are initially unassigned,
but are capable of acquiring a new goal state and learning its
relation to other goals already in place.

gait: a style of animal locomotion. For legged creatures, examples
are a walk or gallop for a horse, or a tripod gait for a cockroach.

game theory: a mathematical theory of bargaining first outlined in
detail by von Neumann and Morgenstern.

General Possibility theorem (Arrow): impossibility of universal
choice rules for total preference orders, given five very
plausible assumptions: non-dictatorship, collective rationality,
Pareto(unanimity), independence of irrelevant alternatives,
conflict resolution.

girth: the length of the shortest graph cycle.

Grammar, graph: a set of rules or productions (and possibly prototypes or
        motifs) that crate or transform one graph into another

graph (undirected):   Gn is a finite non-empty set of n vertices
        (points, nodes) with up to nC2 edges (lines, arcs) between the
         n vertices.

graph: bipartite: see bipartite

graph: chain: see chain

graph: covered: see covered graph

graph: diameter: see diameter

graph: isomorphic: G and H are isomorphic if they have a one to
        one correspondence between their vertex sets that preserves
         adjacencies.

graph: labeled: see labeled graph

graph: line: see line graph

graph: ring: see ring

groups: the permutation group of G are the automorphisms of G.

Ideonomy: a term coined by Patrick Gunkel to describe the study of laws
         underlying conceptual spaces, their manipulations and their
         extensions. See ideonomy.mit.edu.

induced subgraph: for k <n, if all k vertices and edges of gk are in Gn,
        then gk is a subgraph of Gn. The induced subgraph <gk> is one
        where two points in gk are adjacent if and only if they are adjacent in Gn.

information (bits): Shannon information is $[(1/p)Log_2(p)]$, where p =
        event probability. For Anigrafs, bits also used to measure the
         informativeness of an event, namely the extent to which an Anigraf
         model is revised or updated, and hence a measure of meaningfulness.
         See sec.x.

IRM: innate releasing mechanism.

Isomorphic: two graphs are isomorphic if their vertex and edge sets
        are identical.

knowledge depth (kd): two less than the maximum number of levels in
         the partial ordering of a voter's preferences. If tallies are
         conducted using the ideal point and only its neighbors in Gn,
         with all other alternatives third-ranked, then kd=1.

knowledge structure: a model (graph) of the similarity relations

among alternatives. If the knowledge structure is ***shared***,
then all possible individual preference rankings are consistent with the model.

labeled graph: a graph with its vertices distinguished from one another by
names.

landmark: the intersection of at least two causal paths generated by
two independent parameters.

Laplacian matrix: for the undirected graph Gn with n vertices vi, each
assigned to one row and column, the (symmetric) entries are
defined by di if i=j; -1 if i=!=j and there is an edge (i,j); and 0
otherwise, for I,j = 1….n and where di is the degree of vi.

likelihood: in context, C, the probability of a particular observation,
oi, given the presence of an event ei; expressed as p(oi/ei,C).

line graph: the vertices of the line graph L(G) of G consists of the edges of
G, with two vertices in L(G) adjacent whenever the corresponding
edges of G are adjacent. Note that every cutpoint of L(G) will be a
bridge in G.

MDS: multi-dimensional scaling (Shepard, 19xx) A technique for
mapping similarities among items.

mental organisms: agents or daemons in a mind or cognitive system, here
represented as nodes in a graph that shows the communication links
and similarities of goals of the constituents of the cognitive system.

metagraf: a relationship between a set of anigraf models. These
higher order representations include transformations and
dynamics, cast as graphs.

model: given a representational system, a model fills out that
representation with assignments of variables or particular
relations that make explicit how the representation can be used.

multi-scale graph: a graph with a fractal distribution of the shortest mean
path lengths from one vertex to all others. See scale-free graph,
and small world graphs. The latter have been shown to be multi-
scale (Kasturirangan, 1999.)

Natural mode: a correlated set of quasi-independent rules or
regularities describing a natural phenomenon. The presence
of one regularity is highly predictive of the other regularities.

network: here used almost synonymously with a connected graph,
with the typical network being a very large (random) graph.

Pandemonium: the name Oliver Selfridge gave in 1959 to a fanciful pattern
recognition system where feature daemons shouted evidence for types of image features,
which were then heard by cognitive daemons who are each listening for evidence supporting
particular patterns, and these daemons in turn call out to a decision daemon who makes the
final choice.

path: an alternating sequence of distinct vertices and distinct edges
in which each edge is incident with the two vertices immediately
preceding and following it in the sequence.

phase plot: for Anigrafs, a plot showing regions of Condorcet
winners and regions of top-cycles, if present. See Appendix 5
and plates.

planar graph: when drawn in a plane, no two edges meet (or cross)
except at a vertex in which both are incident.

preference order: a partial ordering of alternatives that makes
explicit an individual's first, second, third etc. choices among
those alternatives.

priors: the probability of events at the beginning of a causal chain of
inference; for beliefs, the priors summarize information or
knowledge before the beliefs are updated.

Prisoner's dilemma: a game in which players (partners in crime) may
defect (confess) or cooperate with each other (don't confess) on
each trial. There are payoffs to each player depending on their
choices. For two players, the lowest payoff is to the one who
cooperates when the other defects, who then gets the highest payoff.
The next lowest payoff is when both defect, and the second
highest payoff is when both coorperate.

Proxy: an agent or mental organism that resides in one anigraf, but
votes the wishes of another. See 4.2.

radius: the minimum eccentricity of the vertices.

Ramsay numbers r(G,H): Given two graphs, G and H, r is the smallest
number such that if the edges of the compete graph Kr are colored
red and green, then there is either a set of red edges forming a
subgraph isomorphic to G or a set of green edges forming a
subgraph isomorphic to H. (Read & Wilson, 1998.)

regular graph: all vertices have the same degree.

representation: a formal system for making explicit certain entities or
types of information, together with a specification of how the
system does this. (Marr, 1982.) Note that the representational
form plays an important role in how variables are manipulated.
A simple example is the Arabic, Roman, and binary systems for
representing numbers.

ring: a closed chain; a regular graph with all vertices of degree two.

rooted tree: a tree graph with once vertex distinguished as the origin.

Sarkovskii's lemma (theorem): a cycle of period three in a finite
attractor for quadratic maps implies periodic points with all periods.

scale-free graph: one with the distribution of vertex degrees, k, obeys a
        power law: $p(k) = ck^{-1}$.

sensory order; Hayek's view that perception should be regarded as
        classification of sensory data, thus establishing an order to these
        data. Similarly, the mental order of events in an environment would
        be the internal principles used to place an ordering on relations
        attributed to these events. Note underlying Natural Modes
        assumption, which related physical orders to sensory orders.

similarity: the percent of vertices in two graphs having identical
        adjacencies. Relevant to the similarity of Condorcet outcomes
        and information measures. See 8.2.

small world: the observation that there are short paths of connectivity
        between any two individuals, thought to be about six for the
        optimal iteration of mutual acquaintances (hence dubbed "six
        degrees of separation." A small world graph is highly clustered and
        yet has rather a short median distance for the means of the
        shortest path lengths connecting each vertex to all other vertices.

social network: a graph showing the connectivity relations or interactions
        among individuals or groups or nations, etc.

social order: Sn is the single partial ordering of alternatives that is
        the outcome of a voting procedure that aggregates a finite
        number of weighted partial orderings of these same alternatives.
        More simply, the ranking of all alternatives based on the results of
        a vote, with the winner ranked first, runner-up second, etc.

spectrum (of a graph): the eigen-values for the characteristic polynomial
        describing a graph. See Read & Wilson, 1998.

story line: a directed causal graph depicting a sequence of actions
        and events carried out by at least two players. Simplest story
        is: boy meets girl; a negative force comes into play and boy
        loses girl; the negative force is overcome, and boy reunited
        with girl.

subgraph (induced): for k <n, if all k vertices and edges of gk are in Gn,
        then gk is a subgraph of Gn. The induced subgraph <gk> is one
        where two points in gk are adjacent if and only if they are adjacent in Gn.

tit-for-tat: a strategy for cooperation or defection in iterated games such
        as the Prisoner's dilemma: namely, cooperate on the first move and
        then do whatever the other player did on the preceding move.

TM: a technique for mapping paths of similarity relations among
        items (Richards & Koenderink, 1990.)

top-cycle: a set of k alternatives ai, with k > 2, such that a1 beats a2
        beats a3…..ak-1 beats ak and ak beats a1; also, every
        alternative not in the top-cycle is beaten by at least one

alternative in the top-cycle.

tree: a graph with no cycles.

vector: a set of objects, typically a set of scalars, with rules for addition
(commutative, associative) and scalar multiplication. In R^3 a vector
is usually defined as a directed line between pairs of triples (x,y,z).

vehicle: Braitenberg's creation of a robot-like machine with a very simple
internal structure, and equipped with sensors and motors for
interactions with its environment. Their impact is such that one is
tempted to use psychological language to describe a vehicle's
behavior.

wheel: (Wn) the ring graph Rn-1 with an extra point that covers all
n-1 vertices in the ring.

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