T.M.

From about June 18 to Aug 17, 1956. I attended th Dartmouth summer research project on Artificial Intelligence. About 56 pages were done in this notebook — These later became a ~~M~~ Multilith report of ≈ 55 pp. Also ∥ with this work, a notebook with pages numbered [(83 e.g.] was kept. The pp. of this N.B. ~~will be~~ are refered to e.g. by 83).16. This N.B. has 104 pp. and goes from -1) to 102). Also an attempt at a prelim. report was written — this ran — ≈ 20 pp.

[pp α46 to α85 incl. is only 39 pp]

So 175 pp. written these 2 months: Rather large. Th. research project wasn't very suggestive. Th. main things ~~a~~ of value

1) Write and got report reproduced (very imp.)
2) Met some interesting people in this field.
3) Got idea of how poor most that in this field is.
4) Some ideas:
   a) Search problem may be imp.
   b) These guys may eventually invent a T.M., simply by working more and more interesting special problems. Simon and Newell; Minsky: best candidates — Trench/More is a question mark.
5) Interested some of th. people in T.M. — May be able to get it programed on 704 or IAS computer.

Princeton Inst Adv. Study

A bunch of random, imp. ideas on T.M.: Clean them up later.

.03 1) If we have $3x_i + 2y_i = z_i$ and this works for a few values of i, (x_i, y_i, z_i) being some ntpst., then it should be poss. to realize more quickly that $3\boxed{1} + 2\boxed{2} = \boxed{3}$ is a sort of thing that one can plug a relation (1, 2, 3) into directly, without having to go back to

$(3x_i + 2y_i = z_i) = \boxed{1|2|3|4|5|6|7} \times (3, x_i, +, 2, y_i, =, z_i)$

— i.e. thru th. str. There should be a more direct way to retain 3, +, 2, =, in their proper positions. How to do it: see α89.01

.21 Consider $x_i + 2x_i = 3x_i$. (several values of i gn. as examples)

$= \boxed{1|2|3|4|5|6} \times (x_i, +, 2, =, 3)$

We must give "2" a much hyer aprip than th. set of all integers — similarly with "3". Otherwise th. predictions for $x + 2x = \square\square$ would be

$-\infty x \ldots 1x, 2x, 3x \ldots\ldots \infty x$.

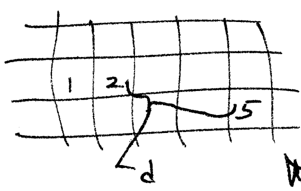
In general in this sort of thing, th. aprip of a set must be < that of any of its ~~elements~~ components. This can be assured, if one has th. special operation, in which an object which is a set of objects can be xfmd into a set of individual objects; each individual U, and each

T.M.

individual U_{aprip} > th. U_{aprip} of th. set of objects. (2

A Mode by which I would like NMTM to work in changing U's of strs, ntps, ngms in time. If an abs (≡ pugm) has been useful for a period of time, then its is not useful for a long time — Then I would want its U to go down rather slowly, since abs's that have once been **useful**, tend to be useful again. — even tho they may be rather un-useful for awhile.

.15 On th. "closeness" rule for strs. It is felt that the distance "d" should be a major contributor to th. decriment of U_{apri} with distance, but that th. difference betw. 5 and 2 should be something irrelevant. — I.e. th. 5 (skipping 3 and 4) can be performed by permuting, repeating or ommiting operations on th. ntp that this str. operates on — it should be done before th. str. is used.



Essentially, then, a str. may consist of only a set of squares with integers in them, but no repetitions or ommissions.

It is, perhaps, possl. to get along with binary strs only. E.G., to get $x_1 \& x_1 \& x_1$, one would first use $\boxed{1|2}$ on (x_1, x_1), then $\boxed{1|\ |2} \times (x_1, \boxed{1|2} \times (x_1, x_1))$.

A trouble mite be experienced with getting th. ngm $x_i \& y_i \& z_i$ from th. ntp (x_i, y_i, z_i) $\boxed{96.06}$

.01 | from $\propto 87.21$ we can use th. ngms $N_1 \equiv 3\,\exists + \exists\exists =$ and $N_2 \equiv \exists X_i\ \exists\exists\ y_i\ \exists\ z_i$ and

$$\boxed{1\,|\,2} \times (N_1, N_2) = 3X_i + 2\,y_i = z_i\ ;\ 3\exists + 2\,x_i = y_i\ \exists\ z_i$$

$$;\ 3\,\exists + 2\,\exists = x_i\ \exists\exists\ y_i\ \exists\ z_i\ .$$

This ambiguity is rather irrelevant and disconcerting. — perhaps this ~~idea~~ idea of str. isn't so hot.

A rather strange, tho perhaps useful way to get these substitutions: multiply (x_i, y_i, z_i) by th. strst $\boxed{1\,|\,2\,|\,3}$, $\boxed{1\,|\,1\,|\,2\,|\,3}$, $\boxed{1\,|\,2\,|\,|\,3}$, etc. — i.e. th. set of all ternar linear strs., in which we have th. order 1, 2, 3. We get an ngmst. $\equiv [N_i^0]$ ~~we can multiply~~ which we can use with $N_1 \equiv (3\,\exists + 2\,\exists =)$ to get

$$\boxed{1\,|\,2} \times (N_1, N_i^0) = \text{all possl. substitutions}$$

of x_i, y_i, z_i, in that order. Unfortunately, there will be many irrelevant ~~products~~ ngms resulting, but maybe they can be elim. somehow.

Actually, if one were given th. ~~[illegible]~~ q.el:

$3X_3 + 2\,y_3 = \boxed{\ \,|\ \,|\ \ }$ one could give only

~~[illegible]~~ $z_3\,\exists\,\exists$ or $\exists\ z_3\,\exists$ $\exists\,\exists\,z_3$ as correct ~~[illegible]~~ answers.

Gen. Methodological Note:

On page (Dart N.B. 99) are a bunch of imp. things that must be done for future T.M. work. Th. foll. seems to be clear: It would be well to work up some good MTM's that used ~~these~~ abstraction sets and hyer order sets. Concurrent with this (befor or after) work out details of NMTM.

Then work out self-improvement program.

Keep eyes open for kinds of methods that need not be built in - open loop, but would arise when T.M. began trying to improve itself.

Also, work out present T.M. in somewhat greater detail than in th. report. Use $U_{ij} \rightarrow \ln \frac{c_{ij}}{T}$ and actually compute th. changes in th. U's, using some simplified approximation method.

List various important groups of problems from (Dart N.B. 99).

E.G.
1) NMTM
2) Self-improvement T.M.
3) Detailed mechanics of present T.M., with no abs. sets, or ~~sets of~~ hyer order sets. General improvements.
4) a) abs. sets
   b) hyer order sets.
5) Physical realization of T.M.
6) General remarks on overall T.M. philosophy.

T.M.

exceptions over $c_1 - c_2$). Th. only trouble, is that in using ngmsts from C_*, one is "safe" — but one ~~to~~ would be losing out on specialized ngmsts that hold over c_2 only.

A ngmst. that has been used much ove $c_1 - c_2$ and little over c_2, should be gn. a rather small U.

An example of ⋙ is $\overset{1}{\boxed{1}}$ in th. "=" ~~cases~~ set of examples. $\overset{1}{\boxed{1}}$ is of low U in c_1, ~~[illegible]~~ because of "s", but it is O.K. for c_2.

Present orientation: That it would be O.K. to use c_1 (averaging over all cases). If there are some ngsts that work over c_2 but not over parts of c_1, then T.M. should make ~~a~~ more complex ngms that ~~[illegible]~~ apply only to ~~[illegible]~~ possl. members of c_2. This orientation is still tentative. I think that th. How to assign "U" is a big. question. should be tentatively done by using c_2 only.

~~2~~ Two ~~[illegible]~~ closely related problems:

1) suppose we have $1\boxed{0}$ with a pngm count of 10, and 2 "cases". [see α90 and α91 for defs. of "pngm" and "pngm count"] [cases of a pngm are q. elements (see α89 for def. of "q. element") to which that pngm applies] suppose we have ~~a~~ $\overset{1}{\boxed{1}}$ with a pngm count of 5, and 4 cases. If we are gn.^{2} ~~a~~ q element with $1\overset{1}{\boxed{}}$ ~~[illegible]~~ in it, how shall we predict?

2) If we have a pngmst with $\overset{1}{\boxed{1}}$ and $1\boxed{0}$ in its how shall we predict $1\overset{1}{\boxed{}}$? Look at th. relative wts. of these 2 pngms.

Discu: Both of th. above ~~[illegible]~~ will not happend often. ~~[illegible]~~ If a q. element is always followed by th. correctly completed element, ~~[illegible]~~ Th. pngms causing trouble will be ~~[illegible]~~ immediately eliminated. If not, in Math T.M.'s, such pngms should have a hy mortality rate. ("A pngm dies" when a counter example is found.

T.M.

in Th. most recent, extensive work on B.G. — from $\approx$ x889 to x892, and x893 to x898 — also much comment on [redacted] pages following x898. I Think $f(M)$ = "aprip" of Th. ngmst.

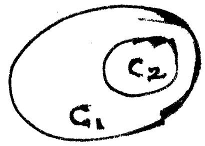
Anyway, say one has ~~picked~~ r examples of This $\square$ ngmst. One also has v ~~ex~~ examples ($v >> r$) of a ngmst. averaged over <u>all</u> sqs. One Then has $F_1(r, x)$ probability of at least x "good" members of This first ngmst.

One has $F_2(v, x)$ proby of at least x "good" membs. of Th. second ngmst. How do F_1 and F_2 cross-couple?

The over-all average case $\equiv C_1$ is at <u>least</u> as relyable as Th. strict $\square$ case $\equiv C_2$. This is because Th. only imp. Things are counter examples. C_1 has all of C_2 as special cases, so C_1 has all C_2's opportunities for counter examples, plus many extra.

Th. real q. is whether to pay much attention to ~~cases of C_2 with no ex~~ ngms That have no counter examples in C_2 but <u>do</u> have counter examples in C_1.

It would seem That Th. above arguement is most directly applicable to Math T.M. (with no probablistic elements) — but is probably also applicable to Th. more general case.



There seems to be somewhat of a paradox here. Apparently in C_1, we get a larger sample size Than in C_2. But C_1 is at <u>least</u> as relyable for prediction as C_2 is. Th. problem seems to be That ~~we expect to have~~ all ngmsts. satisfying C_1 are O.K. for C_2. In fact, ngmsts That hold over C_1 can be expected to be <u>more</u> <u>relyable</u> Than Those which hold only over C_2 (and with some