



CIAO

Collective Intelligence Algorithm for Optimisation

A tool for numeric optimisation of bound-constraint
cost functions using collective intelligence simulation

User Guide

Version 1.24

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CIAO Version 1.25 - User guide

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Overview

CIAO stands for *Collective Intelligence Algorithm for Optimisation*, and is a tool designed to find approximate solutions to optimisation problems whose decision variables take numeric values in the real domain, inspired in the mechanisms of the collective intelligence genome. The software is designed for an academic audience interested in the field of metaheuristics, as an user-friendly visual tool to conduct simulation experiments with a set of benchmark optimisation problems.

The approach of solving an optimisation problem with a collective of artificial agents undergoing an adaptation process is known as a population-based metaheuristics. Instead of using mathematical analysis of aggregated variables describing the phenomena, this approach resorts to modelling the interaction of a group of agents in a simulated environment and trace the evolution of such variables as they interact during the simulation process. In this way, **CIAO** enables the visual inspection of the emerging patterns of agents' self-organisation, in response to changes in the simulation parameters, which can provide useful insights regarding the adaptability of the algorithm to the hidden properties of the problem.

CIAO v1.25 has been released under GNU General Public License (GPLv3); it is available online at:

[?iiTb,ffKQ/2HBM;+QKKQMbXQ`;f#`Qrb2fQM2nKQ/2Hfc](https://github.com/collective-intelligence/collective-intelligence-algorithm-for-optimisation)

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Chapter 1

Description of the tool

1.1 What is CIAO?

The **CIAO** (Collective Intelligence Algorithm for Optimisation) metaheuristic simulates a collective intelligence approach to solving unconstrained continuous optimisation problems. It involves agents known as solvers (wolves) and users (dogs), navigating a solution space to find the optimal coordinates that minimise a cost function associated with an optimisation problem. This tool implements the algorithm as an agent-based model using the Netlogo language.

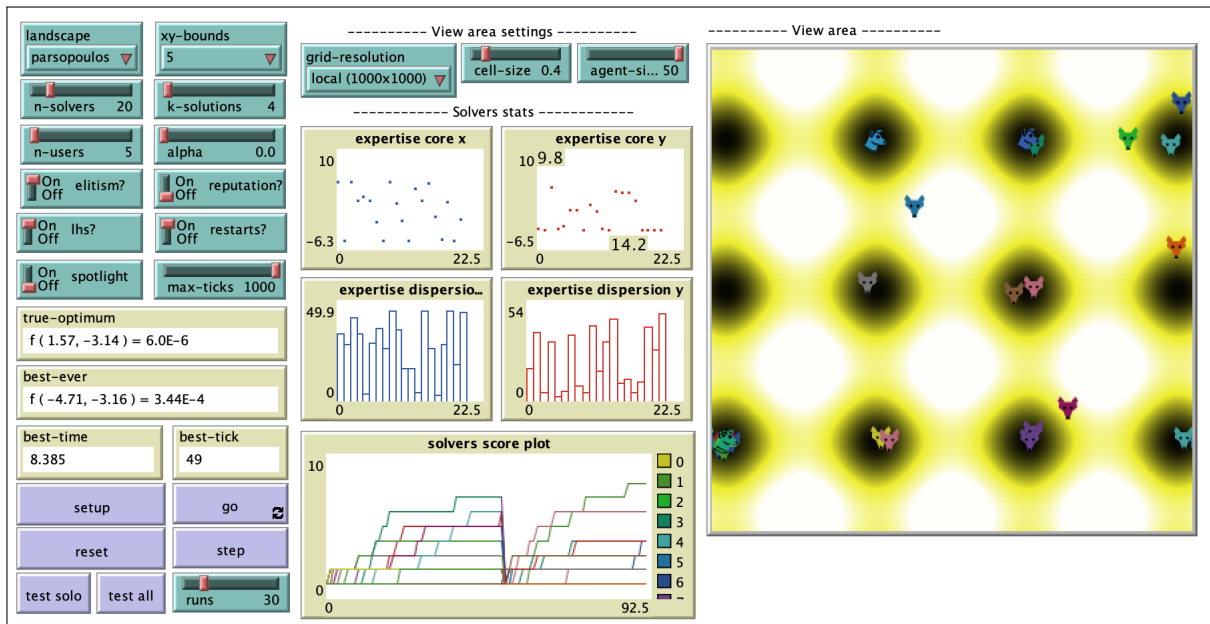
1.2 How it works


Solver agents maintain knowledge about promising sub-regions in the search space, represented as Gaussian distributions, involving their core expertise and their expertise dispersion. Users seek solutions from solvers, and the model incorporates learning and reputation mechanisms to refine the solver's expertise and reward effective solutions.

1.3 How to use it

Firstly, configure the simulation parameters in the simulation user interface:

- **LANDSCAPE:** Chooses the optimisation problem, visually represented in the view or world area. Selection influences the XY-BOUNDS. Refer to the APPENDIX: LIST OF BENCHMARK PROBLEMS section for a description of available benchmark functions.
- **XY-BOUNDS:** Sets the lower and upper bounds of the search space depending on the chosen landscape.
- **N-SOLVERS:** Defines the number of solver agents.



landscape parsopoulos ▾	xy-bounds 5 ▾
n-solvers 20	k-solutions 4
n-users 5	alpha 0.0
<input checked="" type="checkbox"/> On <input type="checkbox"/> Off elitism?	<input checked="" type="checkbox"/> On <input type="checkbox"/> Off reputation?
<input checked="" type="checkbox"/> On <input type="checkbox"/> Off lhs?	<input checked="" type="checkbox"/> On <input type="checkbox"/> Off restarts?
<input checked="" type="checkbox"/> On <input type="checkbox"/> Off spotlight	max-ticks 1000
true-optimum f (4.71, 0) = 1.0E-6	
best-ever f (-4.71, -3.16) = 3.44E-4	
best-time 8.385	best-tick 49
setup	go 
reset	step
test solo	test all
runs 30	

- **K-SOLUTIONS:** Defines the number of solutions a chosen solver attempts to generate.
- **N-USERS:** Defines the number of user agents.
- **ALPHA:** Sets the learning rate for solver adaptation.
- **ELITISM?** Activates the elitism mechanism, which ensures that the best solution found in the current generation is passed on as the center of expertise for one of the solvers in the next generation of the algorithm.
- **REPUTATION?:** Enables or disables choosing solvers based on their scores using roulette wheel selection.
- **LHS?:** Enables or disables Latin Hypercube Sampling of the initial solver population.
- **RESTARTS?:** Enables or disables random resets to prevent stagnation due to premature convergence to local minima.
- **SPOTLIGHT?:** Enables or disables highlighting the global minima in the view or world area.
- **MAX-TICKS:** Sets the maximum number of iterations of the algorithm main search routine.
- **GRID-SIZE:** Adjusts the resolution of the view area. Choose “*web (200x200)*” if running on the model online in the modelling commons website, as server memory constraints limit the amount of cells in the search space. Choose “*local (1000x1000)*” for a higher resolution of 1000x1000 cells if running on a desktop machine, allowing for better discretisation of the search space.

- **CELL-SIZE:** Specifies the size of each grid cell in the view area. Can be adjusted from 0.1 to 2 with a step increment of 0.1. This control enables closer or further inspection of the cells in the view area.
- **AGENT-SIZE:** Controls the size of agent representations in the view area. Adjusts from 10 to 50 with a step increment of 10.

A typical configuration of values for these parameters would be:

- N-SOLVERS: 10
- K-SOLUTIONS: 4
- N-USERS: 5
- ALPHA: 0.5
- ELITISM?: On
- REPUTATION?: On
- LHS?: On
- RESTARTS?: On
- MAX-TICKS: 1000

Next click the **SETUP** button to initialise the model with chosen parameters. And then click the **GO** button to start the simulation. Observe the movement and interaction of solvers and users in the view area of the simulator. You can control the execution of the simulation using the control panel buttons:

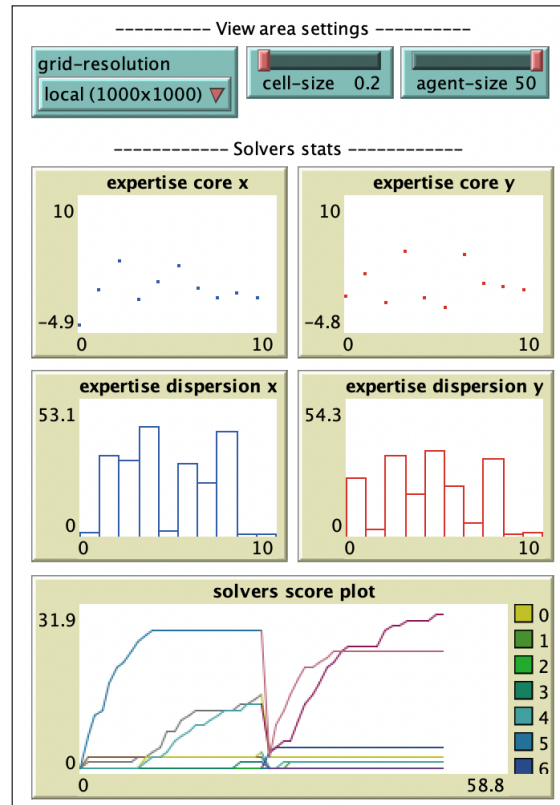
- **SETUP:** Computes and visualises the landscape and initialises agents and global variables of the simulation, according to the given parameters.
- **RESET:** Only initialises agents and global variables of the simulation, according to the given parameters. Also clears plots from previous runs.
- **GO:** Executes the main search routine until stopping conditions are met.
- **STEP:** Executes one iteration of the main search routine.

The model also features two buttons for test experimentation:

- **TEST SOLO:** Executes an experiment with the specified number of repetitions (i.e. RUNS), using the current configuration of model parameters for the selected LANDSCAPE. Results of each run are recorded as either a *hit* or a *miss* depending on whether the algorithm finds the optimum or not. The BEST-TICK, which indicates the time step at which the solution was found in each run, along with the overall success rate within the specified MAX-TICKS, is displayed in the COMMAND-CENTER panel.
- **TEST ALL:** Performs the same experiment but tests the specified number of RUNS on all benchmarks available in the LANDSCAPE list. Aggregated results showing the success rate for each experiment are displayed in the COMMAND-CENTER panel.

1.4 Other distinctive features

- Observe how solvers adapt their expertise to the search space, guiding users towards promising regions.
- Observe how regions with low (black) and high (yellow) values in the landscape are visualised in the view area based on the selected problem (LANDSCAPE).
- Watch the TRUE-OPTIMUM value and notice how the BEST-EVER approaches to it.
- Monitor the BEST-EVER patch, BEST-TICK, and BEST-TIME to understand when and where the best solution is discovered.
- Observe how the EXPERTISE CORE and EXPERTISE DISPERSION parameters of solvers evolve over time in the corresponding plots.
- Analyse the SOLVERS SCORE plot to see how solvers' reputation change during the optimisation process.
- Notice the periodic changes in the SOLVERS SCORE plot when RESTARTS? is enabled.



1.5 Try it yourself

- Experiment with different numbers of SOLVERS and USERS to observe how the collective intelligence adapts to problem complexity.
- Observe how adjusting the learning rate (ALPHA) affects the adaptation of solver expertise. Higher values (closer to 1) make solvers more resistant to exploring new solutions and cling to their currently known best solution. Lower values make them more susceptible to learning from new information and exploring alternative solutions.
- Evaluate the impact of greedy (utilising the single best new solution) and non-greedy (leveraging the average performance of multiple new solutions) learning strategies on solver adaptation using the GREEDY? switch.
- Explore the effects on solvers scores and on user decisions, of enabling or disabling reputation-based solver selection (REPUTATION?).
- Test the impact of Latin Hypercube Sampling of initial solver locations (LHS?).
- Observe the behaviour when random restarts are enabled or disabled (RESTARTS?).
- Toggle the spotlight (SPOTLIGHT?) to visually track the global minimum in the landscape, and how user agents approach to it.

As a side note, we remark that the resolution level can induce quantisation errors during the cost function sampling, therefore the optimum patch coordinates of a given LANDSCAPE can differ depending on the GRID-SIZE. For example, the optimum of ROSENBROCK'S problem is different for 1000x1000 and 200x200 resolutions.

1.6 Extending the tool

Some possible paths for tool extensions are:

- Extend the list of landscape functions of optimisation problems.
- Implement additional user or solver behaviours to enhance the complexity of the collective intelligence dynamics. Techniques such as temporal memory, tabu lists, collaboration mechanisms, or more advanced expertise representation models like a mixture of Gaussians.
- Extend the model to incorporate alternative solver selection strategies to compare their impact on the optimisation process.
- Generalise the model to handle continuous optimisation problems in more than two dimensions ($d > 2$).
- Investigate the adaptation of the model for binary domain problems, exploring how the dynamics change in this context.

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qB/2Hv FMQrM BM QTibKBb iBQM HBi2` im`2- i?2b2 T`Q#H2Kb
lb2`b + M b2H2+i7`QK Mv Q7 i?2 jj #2M+?K `F 7mM+iBQM b B
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+QMi`QH- HBbi2/ BM HT? #2iB+ H Q`/2` ,

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KBMBKmkKX

jX"Q? +?2bpbFv MxQM,@+QMp2t T`Q#H2K rBi? KmHiBTH2 HQ+
bBM;H2 ;HQ# H KBMBKmkKX

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KBMBKmkKX

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7mM+iBQMX

RyX;;?QH/2`+? HH2M;BM; T`Q#H2K rBi? KmHiBTH2 ;HQ# H
i2`Bb2/ #v +QKTH2t H M/b+ T2X

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;HQ# H KBMBKmkKX

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KBMBKmkKX

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H M/b+ T2X

R8X2pv,T`Q#H2K rBi? bBM;H2 ;HQ# H KBMBKmk M/ +Q
H M/b+ T2X

ReX iv b, +QMp2t T`Q#H2K rBi? bBM;H2 ;HQ# H KBMBKmkX

RdXB+? H2rB-MQM@+QMp2t T`Q#H2K rBi? KmHiBTH2 HQ+ H
 R3XBb?` MXJ,T`Q#H2K rBi? KmHiBTH2 HQ+ H KBMBK M/
 KBMBKmkX
 RNXBb?` MXM,QM@+QMp2t T`Q#H2K rBi? KmHiBTH2 HQ+ H KB
 ;HQ# H KBMBKmkX
 kyXBb?` MXeT,Q#H2K rBi? b2p2` H HQ+ H KBMBK M/ b
 T`QMmM+2/ ;HQ# H KBMBKmkX
 kR`bQTQmH-QK,TH2t KmHiBKQ/ H T`Q#H2K rBi? p`vBM;b+ I
 kkX M/QKh?2 +Qbi 7mM+iBQM Bb` M/QKHv ;2M2` i2/- bBK
 BQb r?2`2 QTIBKBb iBQM H M/b+ T2b H +F /2i2`KBMBbiE
 K i?2K iB+ H T`QT2`iB2bX
 kjX_ bi`B;BM,? HH2M;BM; QTIBKBb iBQM T`Q#H2K rBi? ?B;
 H M/b+ T2X
 k9X bi`B;BM "BTQH` p2`bBQM Q7 i?2 _ bi`B;BM T`Q#H2
 k8X bi`B;BM Pzbp2i,B Mi Q7 i?2 _ bi`B;BM T`Q#H2K rBi? M Qz
 ;HQ# H KBMBKmkX
 keXQb2M#`Q+H, bbB+ QTIBKBb iBQM T`Q#H2K rBi? p HH2
 ;HQ# H KBMBKmkX
 kdX+? z2` MXkBKTH2- v2i+? HH2M;BM; QTIBKBb iBQM T`Q#
 M/ M ``Qr ;HQ# H KBMBKmkX
 k3X+? z2` MXT,Q#H2K rBi? H `;2 M/ ~ i ;HQ# H KBMBKmkX
 kNXt?2`2,+QMp2t T`Q#H2K rBi? bBM;H2 ;HQ# H KBMBKmkX
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 KBMBKmkX
 jR?`22@>mKT * KM,QM@+QMp2t T`Q#H2K rBi? KmHiBTH2 H
 jkXoBM+2MT,T`Q#H2K rBi? b2p2` H HQ+ H KBMBK M/ bBM
 MQmM+2/ ;HQ# H KBMBKmkX
 jjXw F?`QpT`Q#H2K rBi? H `;2 M/ ~ i ;HQ# H KBMBKmkX
 q2 2M+Qm` ;2 vQm iQ 2tTHQ`2 p`BQmb #2M+?K`F 7mM+i
 i?2IAOKQ/2H / Tib iQ /Bp2`b2 QTIBKBb iBQM +? HH2M;2b- b
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* ? T i 2 ` k

A M b i H H i B Q M M / 2 t 2 + m i B Q M

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8Xh?2 KQ/2H K BM b+`22M rBHH b?Qr mT,

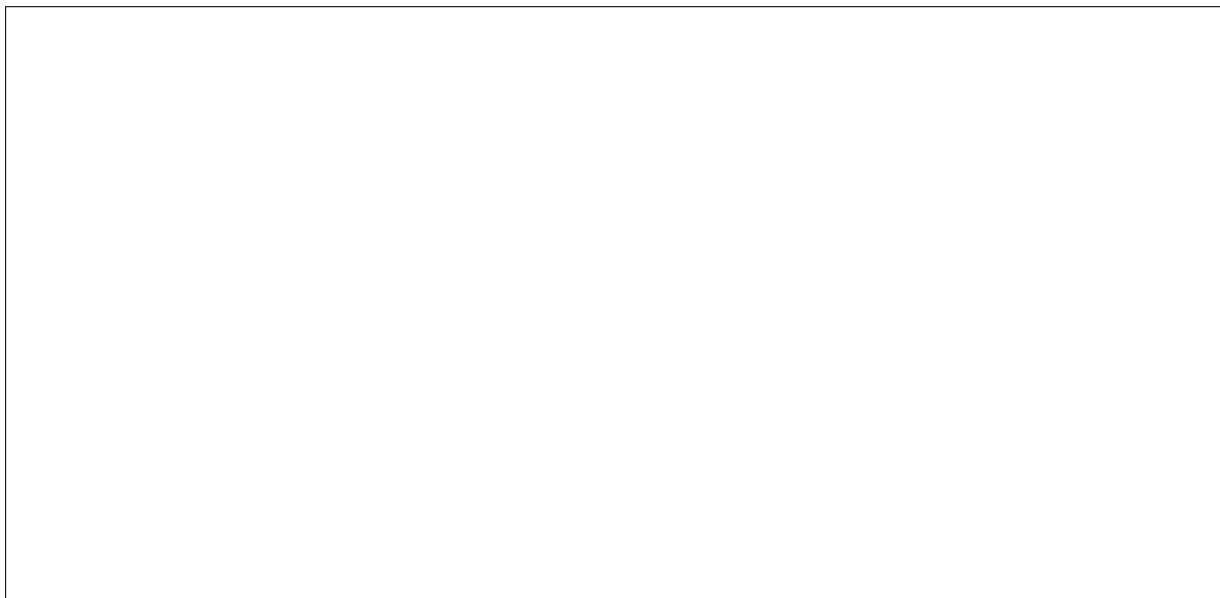


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M/i?2M QM :P5 uQmöHH Q#b2`p2 i?2 2K2`;2M+2 Q7 +QHH2+
QTiBKBb iBQM T`Q#H2Kb BM i?2 bBKmH iBQM pB2r `2 X S
i?2IAO H;Q`Bi?K rBHH #2 /BbTH v2/ BM i?2 KQMBiQ`b M/ TH
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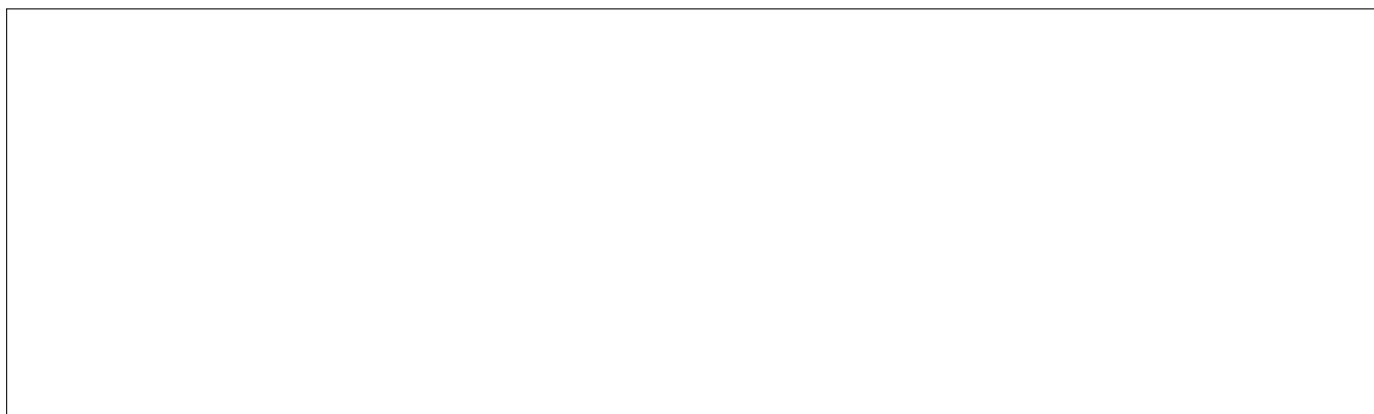
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H`;2`2bQHmiBQM 7Q` i?2 pB2r **CIA**QXm6Mb Qp2b`Tm2`L2iGQ;Q
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RXQrMHQ / M/ BMbi HH i?2 L2iGQ;Q /2bFiQT bQ7ir`2X 6Q`
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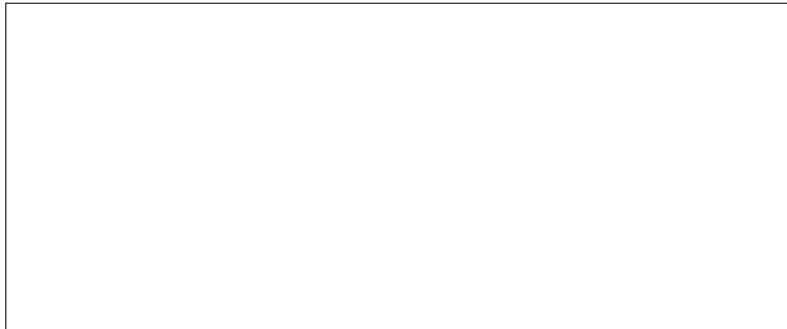


kXQrMHQ **CIA**QKQ/2H }H2 7`QK i?2 KQ/2H r2#T ;2- mbBM; i?2
#miiQM,



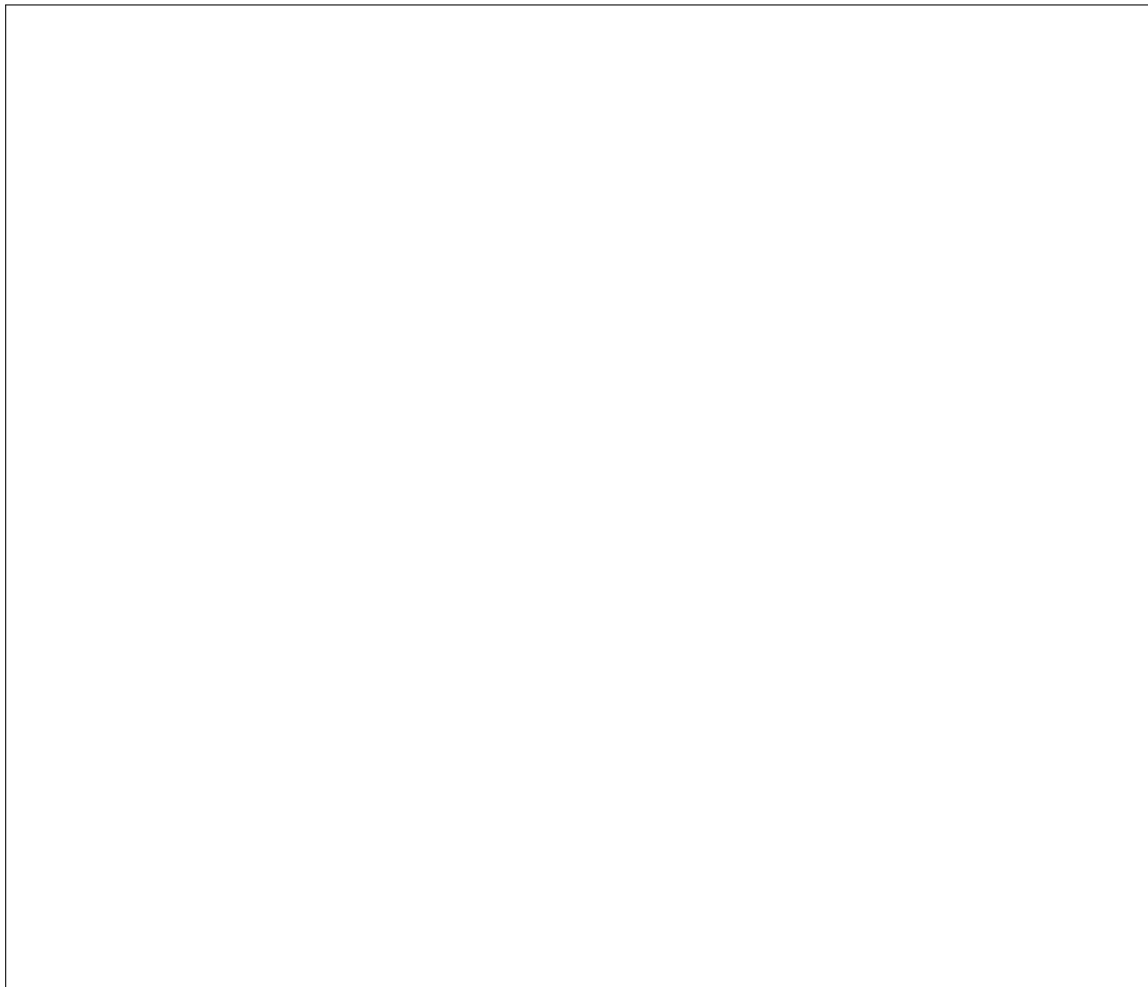
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GQ+ i2 i?2 }H2KQ/XHh+QMi2MQ`XMHQ;Q2 vQm bT2+B}2/V i?
vQm /QrMHQ /2/ T`2pBQmbHv M/ QT2M BiX

9Xh? 2IAO/2bFiQT b+`22M rBHH b?Qr mT,



h? iöb Bi5 *?QQb2 i?2 `mMMBM; T ` K2i2`b BM i?2 +QM
a1hIS- M/ i?2M QM :P5 uQmöHH Q#b2`p2 i?2 2K2`;2M+2 Q
;2M+2 bQHpbBM; QTIBKBb iBQM T`Q#H2Kb BMi?2 bBKmH iB
BM/B+ iQ` 6IAO7 H?Q`Bi?K rBHH #2 /BbTH v2/ BM i?2 KQMBiQ
Hi2`M iBp2Hv- vQm + M `mMi?2 bBKmH iBQM KmHiBTH2
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c _2b2i?2iBK2`QM?27B`biB+F
B7iB+Fb 4 y ( `2b2i@iBK2` )

c TTHb2`+QT2` iQ`b
b2`+?@bQHmiBQMb
mT/ i2@#2bi
iB+F

c _2bi`i;2Mibi`2;mHBMi2`p B7`2bi`ib`22M #H2/
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B7UiB+Fb = K t@iB+FbV Q` U Mv\ i`m2@#2bi@T i+? rBi? (p Hm2 4 (p Hm2) Q7
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iQb2`+?@bQHmiBQMb
bFmb2`b (

  c *?QQb2bQHhp2M/bT rMM2r+ M/B/ i2QHmiBQMhQ`/BMQ Bib
    2tT2`iBb2Q/2H
  H2iKv@bQHhp2` +?QQb2@bQHhp2`
  ? i+?@bQHmiBQMb F@bQHmiBQMb (
    b2it+Q` M/QK@MQ(Kt)H7 Kv@bQHhp2` (bt) Q7 Kv@bQHhp2`
    b2iv+Q` M/QK@MQ(Kv)H7 Kv@bQHhp2` (bv) Q7 Kv@bQHhp2`
  )

  c a p2mb2+m`2MiQ+ iBQM/KQpBi iQ i?2#2bi KQMi;?2M2rbQHmiBQMb
  H2iQH/@T i+?@?2`2
  KQp2@QM@QM2QHmiBQMb (p Hm2)

  c *?2+B7i?2#2bi KQMi;?2M2rbQHmiBQM#2ii2`i? Mi?2mb2`b QrM#2bi
  B72Htp2Hm2 l QrM@#2bi (

    c A7bQ-mT/ i2?2mb2`b QrM#2bi M/`2r`/i?2+?Qb2M Hp2`bBM?2
      M2rHQ+ iBQM
    b2iQrM@#2bi p Hm2
    `2r`/@bQHhp2` Kv@bQHhp2`?2`2

  ) (

    c Pi?2`rBb2`2b2`p22T`2pBQM#2biHQ+ iBQM
    KQp2@QM/@T i+?
  )

  c IT/ i2bQHhp2`2tT2`iBb2M/7Q`;2+ M/B/ i2QHmiBQMb
  mT/ i2@bQHhp2` Kv@bQHhp2`
  bFbQHmiBQMb ( /B2 )

  c TTH2HBiBbKbrBi+?QM
  B72HBiBbK\ (

    c *?QQb22#2biT2`7Q`KBM;Hp2M/+2Mi2Bi`QmM?2#2bi2p2`
      HQ+ iBQM
    bFKBM@QM2QHhp2`b ( p Hm2 ) (
      KQp2@#2bi@2p2`
      b2iKt t+Qb2iKv v+Q`
    )
  )

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2M/

c _2r`/i?2bQHpb`Q`Q#i BMBM#2ii2`bQHmiBQM
iQ`2r`/bQHpb2` (i?2@bQHpb2` #2ii2`@T i+?)
bFi?2@bQHpb2` (
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KQp2@#2ii2`@T i+?JQp2Qi?2#2ii2`bQHmiBQM+ iBQM
b2i#t t+Q` c IT/ i2i?2bQHpb2`#2bibQHmiBQM+QQ`/BM i2
b2i#v v+Q` c IT/ i2i?2bQHpb2`#2bibQHmiBQM+QQ`/BM i2
)
2M/

c IT/ i2i?2bQHpb2`FMQRH2/b2i?2vb2`+7Q`M2rbQHmiBQMb
iQmT/ i2@bQHpb2` (i?2@bQHpb2`)
bFi?2@bQHpb2` (
H2iM2r@tH2iM2r@vcyAMBiB H2x2B #H2M2r+QQ`/BM i2b

b2iM2r@t (t+Q`)KQM@QM2bQHmiBQMb (p Hm2)
b2iM2r@v (v+Q`)KQM@QM2bQHmiBQMb (p Hm2)

c IT/ i2bQHpb2`+Q`2tT2`iBb2b2/QM?2H2`MBMj2
b2iKt U HT? #tV Y UUR @ HT? V M2r@tV
b2iKv U HT? #vV Y UUR @ HT? V M2r@vV
b2itvKt Kv JQp2?2bQHpb2Qi?2mT/ i2HQ+ iBQM

c L`Qr/QrM?2bQHpb2`2tT2`iBb2b2T2`bBQM
b2ibt bt 2tT U@XyyR UiB+Fb KQ/ 8yVV
b2ibv bv 2tT U@XyyR UiB+Fb KQ/ 8yVV
)
2M/

c *?2+B7 Mvmb2? bBKT`Qpi2/2#2bibQHmiBQMmB/Q7`
iQmT/ i2@#2bi
H2i#2bi@MQM@QM2bQHmiBQM (p Hm2)

B7(p Hm2) Q7 #2bi@MQr l (p Hm2) Q7 #2bi@2p2` (
c _2+Q`i?2HQ+ iBQM+F-M/iBK2?2M M2r2#2bi@2p2QHmiBrQM
7QmM/X
bF#2bi@MQr2(#2bi@2p2i+?@?2`2
b2i#2bi@iB+F iB+Fb
b2i#2bi@iBK2 iBK2`
)
2M/

c S2`7Q`K2BMBiBb2im7Q`i?2bBKmH iBQM
iQb2imT
+H2`@ HH c *H2`i?2rQ`H/M/ HH;2Mib
b2imT@b2`+?@H M/bc+a22mTi?2H M/b+ TM/+Qbi7mM+iBQM
b2imT@bQHpb2`b c a2imTbQHpb2;2Mib
b2imT@mb2`b c a2imTmb2`;2Mib
b2imT@;HQ# Hb c a2imT;HQ# H`B #H2b
)
2M/

c _2b2i?2bBKmH iBQM M2r`mMUrBi?Qm+iQKTmiBQM;H M/b+ T;2BM
iQ`2b2i
+H2`@ HH@THQib c *H2`THQKQMbiQ`bK?2T`2pBQ`mrbM
b2imT@bQHpb2`b c _2BMBiB HbQ2p2;2Mib
b2imT@mb2`b c _2BMBiB HbQ2;2Mib
b2imT@;HQ# Hb c _2BMBiB HbQ2# H`B #H2b
)
2M/

c a2imTbQHpb2;2Mib
iQb2imT@bQHpb2`b

```

```

c *H2 `T`2pBQmHp2;2Mib
bFbQHp2`b ( /B2 )

c *`2 i2bQHp2;2Mib
+`2 i2@bQHp2`b M@bQHp2`b (

c b bB;MBbm Hh`B#mi2b
b2ib? T2rQH]
b2i+QH Q`Y URy r?QV
b2ibBx2;2Mi@bBx2

c AMBiB H2x22`iBb2Q/2HM/b+Q`2
b2iKt` M/QK@t+Q`
b2iKv` M/QK@v+Q`
b2ibt` M/QK@7H2 i
b2ibv` M/QK@7H2 i
b2i#t Kt
b2i#v Kv
b2ib+Q`2 R

c a2iBMBiB`HM/QH Q+ iBQM
b2itvKt Kv
)

c A72M #H2+? M;BQ+ iBQrBb?G iBMvT2`+ma#KTHBMH;?B
B7H?b\ ( H iBM@?vT2`+m#2@b KTHBM; )
2M/

c a2imTmb2`;2Mib
iQb2imT@mb2`b
c *H2 `T`2pBQmb2`;2Mib
bFmb2`b ( /B2 )

c *`2 i2M2rm b2`b
+`2 i2@mb2`b M@mb2`b (
c b bB;MBbm Hh`B#mi2b
b2ib? T2/Q]
b2ibBx2;2Mi@bBx2

c b bB;MBBiBQH#2bibQHmiBQM
KQp2@Q2@Q7+?2b
b2iQrM@#2bi p Hm2
)
2M/

c b bB;MBBiBpHHm27bQ`;HQ# H`B #H2b
iQb2imT@;HQ# Hb
b2i#2bi@iB+F y
b2i#2bi@iBK2 y
b2i#2bi@2p2` K t@QMi2@Qp Hm2)
`2b2i@iB+Fb
2M/

c _2bi`i;2MibQT`2p2Mii ;M iBQM
iQ`2bi`i
b2imT@mb2`b
b2imT@bQHp2`b
2M/

c *?QQb2bQH2`Bi?2` M/QKQv;mb/2#v`2Tmi iBQM
iQ@`2TQ`?QQb2@bQHp2`
B72H22`2Tmi iBQM\V (
c *?QQb2bQH2`#`b2/QM?2B`2Tmi iBQM;`QmH2if222H
H2ib+Q`2@HBbi K T ( (i?2@bQHp2`) @ = (b+Q`2) Q7 i?2@bQHp2`) bQ`i bQH
H2iB/@HBbi K T ( (i?2@bQHp2`) @ = (r?Q) Q7 i?2@bQHp2`) bQ`i bQH2`b

```

```

c *QKTm+2nKmH iBb2i`B#miBQMK?2?BbiQ;`Q7b+Q`2b
H2i?Bbi 7Tmi UHBbi U7B`bi b+Q`2@HBbiVV U#mi@7B`bi b+Q`2@HBbiV
H2i ;;b `2/m+2 ( (+mKmH M2ti) @ = b2Mi2M+2 +mKmH UUH bi +mKmHV Y M2ti

c lb2 `QmH2i222Hq+?QQb2bQH p2`+Q`/BMQ i?2+mKmH iBp2
/Bbi`B#miBQM
H2iTQ+F2ib K T ( T @ = T f H bi ;;b ) QK;Tmi222Hq+F2#b
MQ`K HBx+BmK mH iBm2K
H2i# HH M/QK@7HQ i c _QH H?2# HH i?2M+?2+F?2
rBMM2`Q+F2i
H2irBMM2` 7B`bi 7BHi2` ( (BM/2t) @ = # HH I4 Bi2K BM/2t TQ+F2ib ) ` M;2
H2M;i? TQ+F2ib
`2TQ`bQH p2` Bi2K rBMM2` B/@HBbi
) (
c Pi?2`rBb+2QQbMvbQH p2i ` M/QKMB7Q`KHv
`2TQ`QM2@bQH p2`b
)
2M/

c S2`7Q`QK iBM vT2`+ma# 2KTHB MQ`BMBiB bQH p2`Hq+ iBQM b
iQH iBM@?vT2`+m#2@b KTHBM;
c *QKTmi22rB/i?Q7HQ+ iBQM Qib
H2irB/i? k K t@Tt+QM@bQH p2`b

c aTHB2 +?/BK2Mb BQM QM @Qp2`H bTHB iM RT2`bQH p2`M/b KTH2
` M/QKQ+ iBQrB b?BM
7Q`2 +? ` M;2 k ( BM/2t @ =
H2i+QQ`/BM i2b b?m77H2 M@p Hm2b M@bQH p2`b ( bHQi @ = rB/i? UbHQi Y
` M/QK@7HQ i)

c bbB;MQQ`/BMHiQ+ iBQ7M2 +? ;2MiBM MQ`/2`HK MM22-Mbm`BM;
#QmM/QMbi` BMib
U7Q`2 +? bQ`i bQH p2`b +QQ`/BM i2b (
(i?2@bQH p2` +QQ`/BM i2) @ =
bFi?2@bQH p2` (
B72HB2M/2t 4 y (
c t@+QQ`/BM i2
b2iKt U@ t@Tt+Q`+QQ`/BM i2V
b2i#t Kt
b2it+Q` Kt
) (
c v@+QQ`/BM i2
b2iKv U@ t@Tv+Q`+QQ`/BM i2V
b2i#v Kv
b2iv+Q` Kv
)
)
)V
)
2M/

c _2TQ`i2Q/BbTH bQH p2`b+Q`2
iQ@`2TQ`iQr@b+Q`2b (i?2@ ;2Mi)
`2TQ`UrQ`[b r?Q]4] b+Q`2 %]V
2M/

c _2TQ`i2Q/BbTH v2M1b HQ+ iBQM
iQ@`2TQ`Hq+ iBQM b (i?2@ ;2Mi)
`2TQ`UrQ`[m r?Q], U] T`2+BbBQM]-t ]RT`2+BbBQM] W4R
2M/

c .27BMp2B2r`2 b2i iBM;rB?2MHQ /BM?2KQ/2H
iQbi`imT
b2i;`B/@`2bQH m]rBQMk ytk y y]

c ai`imT Bi?+2HHBxR iQT`2p2MpiB2r`2 /BbiQ`iBQrM B M2bBxBM;
UL2iGQ`#QmV
b2i+2HH@bBx2 R
b2i ;2Mi@bBx2 Ry

```

[illegible]

c@@@ @@@@@@Q16LQAQAPBZDLO>QI_PES hAJAw ISA_PL"G GJ L.a* S1a
 @@@@@@@@@@@@@@@@@@@@@@@@@@
 c h?Bf`Q+2/m+QKTmi22H M/b+ Q7i?2+?Qb2MQ b7mM+iBMM
 pBbm HBBZ%
 ca Qm'+E KBHX- u M;-sXaXUkyRXV HBi2` imb2n`p2Q7#2M+?K `F
 7mM+iBQQbhHQ# H
 c QTiKBx iEQW#H2KbKi2`M iBQQQH`MQFJI ?2K iB+JQ /2HHBM/
 LmK2`B+P TiKBb iBQMXX
 chQ // M2rT`Q #H2Kb-KTHWM b2ii?2K i?2K iB+2HT`2bbBQTM?2B`+Qbi
 7mM+iBQQNM2r+ b2bX

```

c a2imTQ`H/M/T i+?bBx2
b2i@T i+?@bBx2 +2HH@bBx2
B72Hb2B/`@`2bQHmiBQM4ytkyy] (
  UB72Hb2
    H M/b+ T2/4K p MYEQ`
    H M/b+ T2?Qb FEQ`
    H M/b+ T2K4B+? H2jBQ`x
    H M/b+ T2pBM+2Mi( `2bBx2@rQ`H/ y kyy y kyy )
    H M/b+ T2x4F? `Qp( `2bBx2@rQ`H/ @8y R8y @8y R8y )
    c HHQI?2QTiBKBb iBQM#H2K2/27BM2/p2i?27Qm[m /` MiQ7
      i?2bQHmiBQM+2
      ( `2bBx2@rQ`H/ @Ryy Ryy @Ryy Ryy )
  V
) (
  UB72Hb2
    H M/b+ T2/4K p MYEQ`
    H M/b+ T2?Qb FEQ`
    H M/b+ T2K4B+? H2jBQ`x
    H M/b+ T2pBM+2Mi( `2bBx2@rQ`H/ y Ryyy y Ryyy )
    H M/b+ T2x4F? `Qp( `2bBx2@rQ`H/ @k8y d8y @k8y d8y )
    c HHQI?2QTiBKBb iBQM#H2K2/27BM2/p2i?27Qm[m /` MiQ7
      i?2bQHmiBQM+2
      ( `2bBx2@rQ`H/ @8yy 8yy @8yy 8yy )

```


V
)

```
c a2imT M;2Q7p`B #H2QQ`/BM 72b2`+?T`Q#H2K
b2itv@#QmMB72Hb2@p Hm2
H M/b+ T2 4FH2v( jk )
H M/b+ T2 #4 H2Q`
H M/b+ T2 K4B+? H2jBQ`x
H M/b+ T2 T4`bQTQhH8b)
H M/b+ T2 #4Q? +?2bpM R( Ryy )
H M/b+ T2 #4QJ?Q`
H M/b+ T2 +4Qbb@BMJ@Q` v
H M/b+ T2 /8tQM@TJ`Q+2
H M/b+ T2 ?4QH/2`@ij#Q+2
H M/b+ T2 ?4Qb FQ`
H M/b+ T2 H4pVQ`
H M/b+ T2 K4iv p Q`
H M/b+ T2 K4Bb?`MXj Q`
H M/b+ T2 K4Bb?`MXj8 Q`
H M/b+ T2 K4Bb?`MXje Q`
H M/b+ T2 p4Bm+2MQ`
H M/b+ T2 x4F?`Q( Ry )
H M/b+ T2 /4K p MYE( R9 )
H M/b+ T2 24;?QH/2( 8Rk )
H M/b+ T2 ;4H/bi2BM@JT( Bk+2
c 6Q`i?27QHHRBMQ#H2KB-mb2?2` M;2(@jkjk) BMbi2 Q7i?2
Q`B;BM(@RyyRyy-) iQ`2/m+2Bb+`2iBx iEQMQ`b
H M/b+ T2 24bQKQ`
H M/b+ T2 b4?`77MXj9Q`
H M/b+ T2 b4?`77MXjk( jk )
c 6Q`MvQi?2T`Q#H2kb2`(@88)/27 mHiM;2
( 8 )
```

V

```
c 1p Hm i22+Qb7mM+iB7QM2`+?T i+?B Mi?2H M/b+ T2
```

```
bFT i+?26
```

```
b2it Tt+Q` Utv@#QmM4bt@Tt+Q`
```

```
b2iv Tv+Q` Utv@#QmM4bt@Tv+Q`
```

```
c LQi2h`B;QM QK27nBM+iBQ2MlnB`2MTnBiM/2;`22bMQi`/B Mbi?mb-
+QMp2`bBQ+MQUR3fTb r bmb2/
```

```
b2ip Hm2
```

```
UB72Hb2@p Hm2
```

```
H M/b+ T2 4FH2v(
@ky 2tTU@yXkiUyX8 Ut k Y v kVVV @ 2tTUYUR3yTfV
Uk TB Tv YQUUR3yTfV Uk TB vVVV Y ky Y 2
```

```
)
H M/b+ T2 #4 H2(
UURX8 @ t Y Ut vVV kV Y UUKXk8 @ t Y Ut Uv kVVV kV Y UUKXe
t Y Ut Uv jVVV kV
```

```
)
H M/b+ T2 #4Q? +?2bpM R(
Ut kV Y k Uv kV @ UyXUUR3yTfV j TB tVVV @ UyX9
+QUUR3yTfV 9 TB vVVV Y yXd
```

```
)
H M/b+ T2 #4QJ?(
Ut Y Uk vV @ dV k Y UUK tV Y v @ 8V k
```

```
)
H M/b+ T2 +4Qbb@BMJ@(i` v
@yXyyyR #UBUBUUR3yTfV tV bBUUR3yTfV vV 2tTUURyy
@ UbU`iUUt kV Y Uv kVVVWVY RV yXRV
```

```
)
H M/b+ T2 /4K p MYE
B72Hb2@pUHm42k V Q` Uv 4 k V ( Ryy)
c B72Hb2@pUHm42k V M/Uv 4 k V ( y )
```

```
B72Hb2@pUHm42k V M/Uv 4 k V ( y )
B72Hb2@pUHm42k V M/Uv 4 k V ( y )
B72Hb2@pUHm42k V M/Uv 4 k V ( y )
(UR @ #UUBUUR3yTfV TB Ut @ kVVVbBUUR3yTfV TB Uv
```

```
@ kVVVV fTBUkV Ut @ kV Uv @ kVVVV 8 V UUK Y Ut @ dV
kV Y Uk Uv @ dV kVV)
```

RN

```

)
H M/b+ T2/4;?Q M@T] B+2
U t @ R V k Y k U U k v k V @ t V k
)
H M/b+ T2/4;Q T r p 2(
@ R U U U R Q U U R 3 y T F V R k b [ i U U t k V Y U v k V V V V V f U y X 8
U U t k V Y U v k V V Y k V V V
)
H M/b+ T2/24; b Q K(
@ R Q U U R 3 y T F V t V + Q U U R 3 y T F V v V V 2 t T U @ U V t @ k
Y U v @ V k V V
)
H M/b+ T2/24;? Q H / 2 ( c M Q i 2 ? i / 2 ; ` 2 2 b M Q i / B M b - ` 2 M 2 2 / 2 7 Q `
b B M m M + i B Q M
U U @ t V b B U U R 3 y T F V b [ i U # b U t @ U v Y 9 d V V V V V @ U b B Y M 9 d V
U U R 3 y T F V b [ i U # b U U t f k V Y U v Y 9 d V V V V
)
H M/b+ T2; Q H / b i 2 B M @ J T ( B + 2
U R Y U U t Y v Y R V k V U R N @ U R 9 t V Y U j U t k V @ U R 9 v V Y U
t v V Y U j U v k V V V V V
U j y Y U U U k t V @ U j v V V k V U R 3 @ U j k t V Y U R k U t k V Y U 9
v V @ U j e t v V Y U k d U v k V V V V V
)
H M/b+ T2; B K K 2 H # H m
U U t k V Y v @ R R V k Y U t Y U v k V @ d V k
)
H M/b+ T2; Q H / 2 ` @ i ] # ( H 2
@ R # U b B U U R 3 y T F V t V + Q U U R 3 y T F V v V 2 t T U U R @ b [ U i U t
k Y v k V T F V V V V
)
H M/b+ T2; Q b F E
U R @ U 3 t V Y U d U t k V V @ U U d f j V t j V Y U y X k 8 U t 9 V V V
U U v k V 2 t T U U @ v V V V
)
H M/b+ T2; H 2 p j v (
U b B U U R 3 y T F V T B U R Y U t @ R V f 9 V V k V
Y U U U R Y U t @ R V f 9 V @ R V k V b B U U R 3 y T F V U U B U R Y
U t @ R V f 9 V V Y R V V k V
Y U U U R Y U v @ R V f 9 V @ R V b B U U R 3 y T F V U U k T B U R Y
U v @ R V f 9 V V V V k V
)
H M/b+ T2; K 4 i v p (
U y X k e U U t k V Y U v k V V V @ U y X 9 3 U t v V V
)
H M/b+ T2; K 4 B + ? H 2 j B (+ x
@ R b B U U R 3 y T F V t V U b B U U R 3 y T F V R U t k V T B V V U k
R y V V
@ U b B U U R 3 y T F V v V b B U U R 3 y T F V k U v k V T B V V U k
R y V V
)
H M/b+ T2; K 4 B b ? ` M X j (
b [ i U # U + Q U U R 3 y T F V b [ i U # U U t k V Y v V V V V V Y y X y R U t Y v V
)
H M/b+ T2; K 4 B b ? ` M X j 8 (
U U U b B U U R 3 y T F V U Q U U R 3 y T F V t V Y + Q U U R 3 y T F V v V V k V V
k
Y U Q U U R 3 y T F V U b B U U R 3 y T F V t V Y b B U U R 3 y T F V v V V k V V
k Y t V k V
Y U X y R t V Y U X R v V
)
H M/b+ T2; K 4 B b ? ` M X j e (
@ R H M U U U R 3 y T F V U Q U U R 3 y T F V t V Y + Q U U R 3 y T F V v V V
k V V k
@ U Q U U R 3 y T F V U b B U U R 3 y T F V t V Y b B U U R 3 y T F V v V V k V V
k Y t V k V
Y X R U U t @ R V k Y U v @ R V k V
)
H M/b+ T2; T 4 ` b Q T Q j H Q b
+ Q U U R 3 y T F V t V k Y b B U U R 3 y T F V v V k
)

```

H M/b+ T2`4bi`B;BM
 ky Y UUt kV @ -RQUUR3yTfV Uk T V t VV Y UUV kV @ Ry
 +QUUR3yTfV Uk T V vVV
)
 H M/b+ T2`4bi`B;BQ77b2(
 ky Y UUt @ RXRkjV kV+QUUR3yTfV Uk T V Ut @ RXRkjVVV
 Y UUV @ RXRkjV kV+QUUR3yTfV Uk T V Uv @ RXRkjVVV
)
 H M/b+ T2`4bi`B;B#BTQ#(
 ky Y UUt Y RV kV @ QUUR3yTfV Uk T V Ut Y RVVV Y UUV
 @ RV kV @ RQUUR3yTfV Uk T V Uv @ RVVV
)
 H M/b+ T2`4b2M#`JQ(+F
 Ryy Uv @ Ut kVV k Y UR @ tV k
)
 H M/b+ T2b4+? 77MXjk(
 yX8 Y UUR3yTfV Ut k @ v kVV kV @ yX8V f UR Y UyXyyR Ut
 k Y v kVVV kV
)
 H M/b+ T2b4+? 77MXj9(
 yX8 Y UUR3yTfV bBUUR3yTfV #Ut k @ v kVVVV k @
 yX8V f UR Y UyXyyR Ut k Y v kVVV kV
)
 H M/b+ T2b4? 2]2(
 t k Y v k
)
 H M/b+ T2b4? 2`2 @ Q77(b2i
 Ut @ jV k Y Uv Y jV k
)
 H M/b+ T2i4`22 @ ?mK72H(
 Uk Ut kVV @ URXy8 Ut 9VV Y UUt eV f eV Y Ut vV Y Uv kV
)
 H M/b+ T2p8M+2Mi
 B72Hb2 @ptHmyXk8 Q`v l yXk8 (y)
 (@R bBMUR3yTfV Ry UHQutV RyV @bBMUR3yTfV Ry
 UHQutV RyV)
 (@R bBUUR3yTfV Ry HMUtVBUUR3yTfV Ry HMUvVV)
)
 H M/b+ T2x4F?`Qf
 Ut k Y v kV Y UUYX8 tV Y UYX8 k vVV k Y UUYX8 tV Y UYX8
 vVV 9
)
 c Pi?2`rBb2` M/QK M/b+ T2
 (` M/QK @ M Qy 8 y)
 V
)
 c aKQQQmî M/QK M/b+ T2`#2ii2`pBbm HBx iBMQ2 `+277B+B2M+v
 B7H M/b+ T2`4M/QK(
 bFKBM @M@T7+92(p Hm2) bFT i+?2BM@` /Bmb b2ip Hm2 p Hm2 @
 ` M/QK @ 7Hy i)
 `2T2 i Ry (/B77mb2 p Hm2 R)
)
 c 6BMi?2i`m2#2biT i+?U;HQ# KBMBK# b2/QM?2+?Qb2MM/b+ T2
 UB72Hb2
 c 6mM+iBQBMi7k;HQ# KBMBK
 H M/b+ T2/8tQM@T] b+22i`m2@#2bi@T i+? KBM @M?@Qp7 Hm2))
 c 6mM+iBQBMi79;HQ# KBMBK
 H M/b+ T2+4Qbb@BM]@Q` v
 H M/b+ T2?4QH/2`@ij#Q7
 H M/b+ T2b4+? 77MXj9(b2i`m2@#2bi@T i+? KBM @M?@Qp7 Hm2))
 c >BKK2H#7H m9;HQ# KBMBK#mi8 2K2`;2m2iQ /Bb+`2iBx iBQ`MQ`b
 H M/b+ T2?4KK2H#H(b2i`m2@#2bi@T i+? KBM @M?@Qp7 Hm2))
 c 6mM+iBQBMi7Rk;HQ# KBMBK
 H M/b+ T2T4`bQTQ#H(b2i`m2@#2bi@T i+? KBMT @M?@Qp7 Hm2))

c 6mM+iBQMiE k;HQ# KBMBK
H M/b+ T2pBM+2Mib2i`m2@#2bi@T i+? KBMT@M-Qp Hm2))

c HHQi?2+Qb7mM+iBQMpb bBM;H2Q# KBMBK
(b2i`m2@#2bi@T i+? T i+BM@2iM2 @+Q72 bp Hm2))

V

cc a+ H2i+?2bQHQB?BMBMM/K t p Hm2bBKBi7bQ`pBbm HBb iBnQ`MQb2b
H2iKBM@p H KBM (p Hm2)2Q7
H2iK t@p H K t (p Hm2)i+Q72 b
bFT i+?2b(
UB72Hb2

c S`Q#H2#2bi2`pBbm HBm2/BM;BM2+QHQB+ H2
H M/b+ T2 4FH2vQ`
H M/b+ T2#Q? +?2bpM XJQ`
H M/b+ T2+4Qbb@BMJ@Q` v
H M/b+ T2/4K p MYEQ`
H M/b+ T2/4QTr p2Q`
H M/b+ T2b4? 772MXkQ`
H M/b+ T2b4? 772MX9Q`
H M/b+ T2pBM+2Mi
(b2iT+QHQB` b+ H2@+QHQB` v2HHQr p Hm2 KBM@p H K t@p H)

c S`Q#H2#2bi2`pBbm HBm2/BM;[m`2QQi2+QHQB+ H2
H M/b+ T224bQKQ`
H M/b+ T224;?QH/2Q`
H M/b+ T2?QH/2`@ij#Q`2
H M/b+ T2K4B+? H2ijBQ`x
H M/b+ T2K4Bb?`MXjeQ`
H M/b+ T2T4`bQ TQ`H2Qb
H M/b+ T2x4F?`Qp
(b2iT+QHQB` b+ H2@+QHQB` v2HHQr p[H2Kt@pMH@p H

c S`Q#H2#2bi2`pBbm HBm2/BM;Q;`Bi?KB+H2
H M/b+ T2#2 H2Q`
H M/b+ T2/4tQM@Tj`Q+2
H M/b+ T2;4H/bi2BM@JTQB+2
H M/b+ T2#4QJ?Q`
H M/b+ T2`4b2M#`JQ+F
(b2iT+QHQB` b+ H2@+QHQB` v2HHQr p Hm2 KBM@p H HQ; K t@p H RXYR)

H M/b+ T2`4bi`B;B MQ`
H M/b+ T2`4bi`B;BQ77b2Q`
H M/b+ T2`4bi`B;B#BTQ`
(b2iT+QHQB` b+ H2@+QHQB` v2HHQr p Hm2 KBM@p H HQ; K t@p H RXY8)

H M/b+ T2?4KK2H#H`m
H M/b+ T2H2pJvQ`
H M/b+ T2K4iv`p Q`
H M/b+ T2K4Bb?`MXj Q`
H M/b+ T2b4?2J2Q`
H M/b+ T2b4?2`2@Q72Q`2i
H M/b+ T2i4`22@?mKKT2H
(b2iT+QHQB` b+ H2@+QHQB` v2HHQr p Hm2 KBM@p H HQ; K t@p H RXR)

H M/b+ T2?4b`FQ`
H M/b+ T2K4Bb?`MXj8
(b2iT+QHQB` b+ H2@+QHQB` v2HHQr p Hm2 KBM@p H HQ; K t@p H RyXR)

c 6Q`MvQi?2T`Q#H2H2 HQ;`Bi?K/B7 mHbi+ H2
(b2iT+QHQB` b+ H2@+QHQB` v2HHQr p Hm2 K4BM@pp HH YH QXyyRV
RXY8)

V

)

cc a2ibTQiHB;QMQ`Q77
B7bTQiHB;?i`4n2(r i+?QM2@iQm2@#2bi@T i+?)
2M/

c a?Q`i2b2imT`Q+2/m7Q`bQK22T`2b2Mi iBpM/b+ T2Q#H2Kb

```

iQ b2imT@b2 `+?@H M/b+ T2b@b?Q`i
c a2imTrQ`H/M/T i+?bBx2
`2bBx2@rQ`H/ @8yy 8yy @8yy 8yy
b2i@T i+?@bBx2 +2HH@bBx2
/BbTH v

c *`2 i2i?2k. H M/b+ T2+Q`/BMQ i?2+?Qb2HQB i7mM+iBQM#QmM/
+QMbi` BMib
b2itv@#QmM72Hb2@pHMM2b+ T224;?QHJ2( 8Rk ) ( e )
bFT i+?2b
b2it Tt+Q` Utv@#QmM4bt@Tt+Q`
b2iv Tv+Q` Utv@#QmM4bt@Tv+Q`

b2ip Hm2B72Hb2@p Hm2
H M/b+ T2b4?2J2(
B72Hb2@pHm228V Q` Uv 4 8V
( Ryy )
( t k Y v k )
)
H M/b+ T2b4?2`2@Q77b2i
Ut @jyy Utv@#QmM4bt@Tt+Q` k Y Uv Y jyy Utv@#QmM/b f
K t@Tt+Q` k
)
H M/b+ T2`4bi`B;BM c LQi2? i /2;`22bMQi` /B Mb`2 M22/27Q`
i?2+Qb7mM+iBQM
ky Y UUt kV @ +QUUR3yTb Uk Tb tvV Y UUv kV @ Ry
+QUUR3yTb Uk Tb vVV
)
H M/b+ T2`4b2M#`JQ(+F
Ryy Uv @ Ut kVV k Y UR @ tV k
)
H M/b+ T2`4BKK2H#H m
UUt kV Y v @ RRV k Y Ut Y Uv kV @ dV k
)
H M/b+ T224;?QHJ2( c LQi2? i /2;`22bMQi` /B Mb`2 M22/27Q`
i?2bBMmM+iBQM
U U@ tVbBMUR3yTb b[`i U#bUt @ Uv Y 9dVVVVV @ UvBM 9dV
UUR3yTb b[`i U#bUUt f kV Y Uv Y 9dVVVV
)
( ` M/QK@MQ i8yy ) h?2H bi+ b2Bb ` M/QK M/b+ T2
V
)

B7H M/b+ T2`4M/QK(
c aKQQQmi?2` M/QK M/b+ T2
bFKBM@M@T7+92(p Hm2) bFT i+?2BM@` /Bmb b2ip Hm2 p Hm2 @
` M/QK@7Hjy i )
`2T2 i Ry ( /B77mb2 p Hm2 R )
)

c 6BMi?2i`m2#2biHQ+ iBQM
B72Hb2 M/b+ T2`4BKK2H#H m
c ]?BKK2H#H2trB#B9b;HQ# KBMBK82K2`;2m2iQ/Bb+`2iBb iBQM
2`Q`b
b2ii`m2@#2bi@T i+? KBM@M?2Qp7 Hm2)
) (
c HHQi?2+Qb7mM+iBQMp2 bBM;H2Q# KBMBK
b2ii`m2@#2bi@T i+? T i+BIM@2IM2@+Q72(p Hm2)
)

c a+ H2 i+?2bQHQB i?BM Hm2BKBib
H2iKBM@p H KBM (p Hm2)2Q7
H2iK t@p H K t (p Hm2)i+Q7b
bFT i+?2b b2iT+QHQ` b+ H2@+QHQ` v2HHQr p Hm2KKBM@p IRXyQ;)

c a2ibTQiHB;B7brBi+?QM
B7bTQiHB;?i`4n2( r i+?QM2@iQm2@#2bi@T i+? )
2M/

cccc1L.P66AGcccc

```


* ? T i 2 ` 9

a Q 7 i r ` 2 H B + 2 M b 2

CIAOp2`bBQM RXk8

*QTv`B;?i Ü kyk9 a2`;BQ _QD b@: H2 MQ- GBM/b v •Hp `2x- J

h?Bb T`Q;` K Bb 7`22 bQ7ir `2, vQm + M `2/Bbi`B#mi2 Bi M
i?2 i2`Kb Q7 i?2 :LI :2M2` H Sm#HB+ GB+2Mb2 b Tm#HBb?2/
6QmM/ iBQM- 2Bi?2` p2`bBQM j Q7 i?2 GB+2Mb2- Q` U i vQm`

h?Bb T`Q;` K Bb /Bbi`B#mi2/ BM i?2 ?QT2 i? i Bi rBHH #2 mb
Lu q __ Lhuc rBi?Qmi 2p2M i?2 BKTHB2/ r `` Miv Q7 J1_*> Lh
Q` 6AhL1aa 6P_ S _hA*IG _ SI_SPa1X a22 i?2 :LI :2M2` H S
GB+2Mb2 7Q` KQ`2 /2i BHbX

uQm b?QmH/ ? p2 `2+2Bp2/ +QTv Q7 i?2 :LI :2M2` H Sm#HB-
i?Bb T`Q;` KX A7 MQi- vQm + M /QrMHQ / Bi 7`QK,

?iiTb,ffrrrX;MmXQ`;fHB+2Mb2bf;XH@jXyX2MX?iKH