DEM Center Users' Guide

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1 Preface

DEM centre is a program package written in C#, which is the heart of digital evolution. You can create any size of labyrinths with any DEM workers and wumpuses, traps and gold. The system helps you to understand what happened to evolutional workers in this peculiar world. The system saves all events and workers into a Postgres database, so PostgreSQL 9.6 or later version has to be installed previously. PgAdmin is optional, but very useful tool, so it is also suggested to install. Use the Master to start thousands of DEM workers to discover the world. Start Analyser in order to understand the events.

2 Installation

- 1. Download the ziped (dc.zip) package from this site (Download menu)
- 2. Copy it to the desired directory and unzip
- 3. Download Postgres 9.6 or later version and install it
- 4. Download and install pgAdmin 4.x (optional)
- 5. Create a postgres user with name: wumpus with password: wumpus with admin rights (use postgres command line or pgAdmin). If you want to use your own parameters, open *config.cfg* file, from the program directory and put your data into it (username: wumpus, password: wumpus, host: localhost). You may also need to change the content of *configAdmin.cfg* file (username postgres, password root, database postgres, host localhost) if your data are different from them.
- 6. Start DC.exe
- 7. Let's start the simulation.

$3 \quad DC$

DC.exe is a frame program, which organize your work. You can make the followings (Figure 1):

• You can start DCDemo.exe, which demonstrates graphically the movements of DEM entities (workers) in small labyrinth. There is no database connection and knowledge base creation in this case.

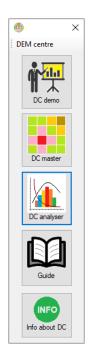


Figure 1: DC Centre form: Demo, Master, Analyser modules can be launched from here.

- If you are going to make simulations, start DCMaster.exe.
- If you already have simulation results, you can use DCAnalyser.exe to analyse databases, to understand what have happened to evolutional entities, and what the fate of DEM workers is.

The easiest way to start click to DC.exe, and start further modules from here.

4 DCDemo

DCDemo.exe demonstrates graphically the movements of DEM entities (workers) in small labyrinth (Figure 2). There is no database connection and knowledge base creation in this case. Here you can create workers, any sized labyrinth with many wumpuses, traps and gold bars. Do not create to much (suggested only one), because picture may become confusing. If worker has died the live flag emphasized with black colour. If the worker found gold, the live flag became green, the 'gotcha' flag turns *true* emphasized with green colour.

Í <u>,</u>							Der	mo				_ D X
START		Start Io	cation: 0,	0	Labirynth	size: 10	Num	of worker	s: 1	Num of wumpu	ıs, traps, gold: 1	Show legend
0							111	110		[Le	egend
1	2							109	108			Empty field
	3		15					100	99-10			Gold
	4-24	5-25	14-16	17				91-97	90-96			Glitter
	23	6-26	7-9-11	10-18				92-94	89-95			Trap
59	22-58	21-27	8-12-20	19			86	87-93	88			Breeze
60-62	57-61	28-32	29-31				85					Wumpus
63	64	33-49	30-52	53-67			84	77-83				Stench
40	37-39	34-36	35-47					76-78	81			
43	42-44	45	46-70	71	72	73	74	75-79	80			
Final field	d: 7,0	Live: False	Gotch	a: False	Worker p	ath count	: 112 Er	nergy leve	:l: 0			

Figure 2: DCDemo: Labyrinth with legend and movements can be seen. Numbers symbolize the step number when the certain field was entered.

OC Master, v2.5.0.0					_		×
Select a database V Database V	Edit/cre	eate workers	Edit/create labyrinths	Show/Edit parameters	Start iteration	Stop iteration	
Set up run parameters Observe coincidence Start position from parents at birth		Iteration prog Labyrinth : Initial work	size: ker count:				
Start position: 0,0 format: 10,0 (x, y)		2.119 10					

Figure 3: The DCmaster starter screen: This is where you can open an existing database (invasion) or create any labyrinths, DEM workers, and you can set up simulation parameters.

5 DCMaster

If you are going to make simulations, start DCMaster.exe (Figure 3). First, you need to create a new database (simulation) in the *Database* menu (Figure 4). Also in it you can edit/display config file (Figure 5), which contains connection parameters to Postgres and existing wumpus databases.

After creation you should select this new database. Click to 'Select a database' combo box to select the desired database. If you created a new database (new simulation), or you selected an existing one, you can create DEM workers by clicking Edit/Create workers menu (Figure 6). You can also create any size of labyrinth by clicking Edit/Create labyrinths menu (Figure 7), or edit existing one. You can set the size of labyrinths, and the number of wumpuses, traps and gold bars in it.

You can set up parameters (Figure 8) of the world: initial worker energy, movement costs, wumpus, trap, gold energy content, replication energy level, replication rate (default is 2), etc.

In the *Database* menu there are three further sub menus. The first is *Delete workers*, which delete all existing workers from the invasion database and worker related table such as worker_path and knowledge. It is useful if you wish to start a new invasion with new workers, but in old labyrinths. To click to *Delete all tables content* menu item deletes every table's content from the selected (actual) database such as workers, labyrinths, logbook, worker_path.

Select a database v		Edit/cro	eate workers	Edit/create labyrinths
	Create	new dat	abace	
			abase	
<u>.</u>	Config	g file		
Set up run parameters	Show	logbook		s data
	Delete	workers		*
Observe coincidence	Delete	ete all tables content		count:
	Delete	database	2	ber:
Start position from parents at birth			Living work	
Start position: 0,0 format: 10,0 (x, y)			Living No.	

Figure 4: Database menu, where you can create new database, or edit config file

Config	file ×
username: wumpus password: wumpus host: localhost	
Quit without save	Save changes

Figure 5: Database/Config file menu, where you can edit/view the config file content

en e	dit/create work	ers		_		×
	up workers ber of workers: Create workers	8]			
	worker_id	live	energy	loc_wumpus		loc_tra ^
•	0	\checkmark	200			
	1	\checkmark	200			
	2		200			
	3	\checkmark	200			
	4	\checkmark	200			
	5		200			
	6		200			
	7		200			
	8		200			
	9		200			
	10		200			
	11		200			
	12		200			~
<						>
	I	Delete	selected row		C	lose

Figure 6: Edit/Create worker menu: here you can create or delete the selected workers. The number of workers has to be set up before clicking to 'Create workers' button.,

🖳 Edit	/create lab	yrinth				_		×
Labyri	p labyrinth inth size:	umpus, traps, go	ld:		labyrinth port labyrinths from database	:		~
	(Create labs			Import labyrinths			
	lab_id	lab_size	number_of_wum	ipus	wumpus_position			
•	0	500	50		14,386;133,435;89,268;358	,60;50,315	;363,35;4	04,261
<			Dele	te			Clos	>
			Dele				CIOS	

Figure 7: Edit/Create labyrinth menu: here you can create any size of labyrinths with any number of wumpuses, traps and gold bars.

	name	value	parameter_id	^
	Initial_worker_energy	200	0	
	Gold_energy	1000	1	-
	Movement_costs	-1	2	
	Trap_energy	-400	3	-
	Wumpus_energy	-1000	4	-
	Replication_energy_level	5000	5	
	Replication_rate	2	6	
•*				N

Figure 8: Set up parameters menu is for adjusting the circumstances in the artificial world (labyrinths). You can edit world parameters if you change values. The changed value is stored if you select the next record.

If every necessary parameter has been set up, and labs and workers have been created you can start the simulation by clicking to *Start iteration* button. You can observe events in the main form, where you can see the labyrinth size, initial workers' count, current iteration number and living worker count. The better way of observation is to start DCAnalyser.exe which has many functions to display and analyse data.

If you want to cancel the simulation process, click to *Stop iteration* button. Every simulation has a report file where the main metadata are store after the process interruption (either stopped by the user or the living worker number became zero).

6 DCAnalyser

If you already have simulation results, or you have just started the simulation process by clicking *Start iteration* button, you can use DCAnalyser.exe to analyse databases (invasions data), to observe events, to understand what happened to evolutional entities, and what the fate of DEM workers are. There are built-in queries, charts and picture to help your understanding. You can create your own selections too (Sql menu), and you can display results (*Diagrams* menu). In *Selection* menu you can see discovered fields of a labyrinth. Figure 9 demonstrates the complexity of DCAnalyser. You can see a labyrinth not only in tabular form, but in graphics too if you click to a labyrinth with right mouse button.

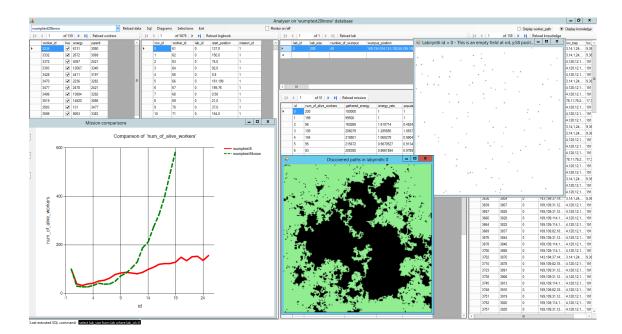


Figure 9: DCAnalyser: This module has wide range functions of data analysis. You can see data in tabular form, and graphics too, such as charts or images

Select a database	-	Data	SqI	Diagrams
d25bigworld3		rkers		
d25bigworld4		KEIS		
d25ccc				
d25prob				
d25prob3				
d25prob4				
d25prob5				
d25prob6				
d25prob7				
d25prob8				
d25proba				
d25probe2				
d25smallworld	_			

Figure 10: Click to 'Select a database' combo to select a database which contains every data of the selected simulation

👍 Analyser on 'd25	iprobe2' invasion database							
d25probe2	•	Data	Sql	Diagrams	Selections	Exit		Monitor on/off
∃∥∢ ∢ 1	, összesen: 1148 🕨 🔰 Reload	workers			E [4 4]	1	, összesen: 440384 🕨 🔰 Rela	oad logbook

Figure 11: This the main menu of DCAnalyser.

After DCAnalyser.exe start you need to analyse the database. Select a database (simulation) to analyse events and data (Figure 10). When a database has been selected its content were loaded to different tables (workers, logbook, labyrinths, worker-Path).

After selection of a database the main menu becomes enable. *Data menu* item allows you to reload database names or tables' content if a new simulation database was created in **DCMaster**, and you are going to observe it. If currently a completed simulation database is open you can see the simulation report.

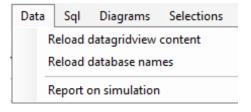


Figure 12: This the main Data menu. Here you can reload simulation data, and see the simulation report.

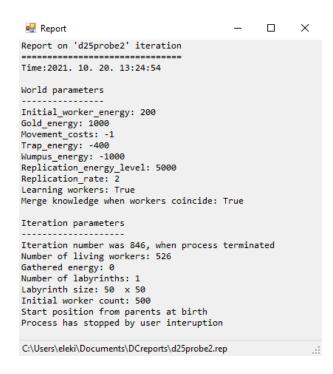


Figure 13: A simulation report

If you check the monitor option in main menu bar you can observe the number of alive workers in real time, during the simulation.

You can make any selections with *Sql* menu (Figure 14). if you know Sql you can create your own Sql query, and you can see it in tabular form. If you choose *Display charts from any Select* sub menu you can see the result in chart form.

In *Diagram* menu (Figure 15) you can see simulation data on charts: population (number of alive workers), population rate, gathered energy, energy rate, and fitness of groups. You can also compare any data from any simulation. If you click to the special icon (white arrows) an sql command field

Data	SqI	Diagrams	Selections	Exit				
workers		SQL window						
loc tra		Display charts of any Select						

Figure 14: With Sql menu you can create arbitrary Sql selections. You can display results in tabular or graphic form

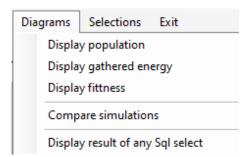


Figure 15: You can draw charts if you choose any sub menus from *Diagram* menu.

displays, where you can see actual Sql statement.

You can not only display charts on the certain database (simulation), but compare data of different simulations (Figure 16). If you choose *Compare simulations* menu you can choose desired simulation database name and data type to display.

Choose *Selections* menu (Figure 17) if you wish to see workers' knowledge for selected labyrinth or for all labyrinth. If the workers knowledge is interesting, first you should select a certain worker by clicking to a record in'workers' table. If you did not select labyrinth the selected knowledge is valid for all labyrinths.

In *Selections* menu you can display the discovered fields of a selected labyrinth (Figure 18). You can see individual or collective knowledge as an image. The union of individual results is the collective knowledge.

You can see a labyrinth graphically if you make a mouse click with right mouse button to a record in lab table data grid view. I this was you will see the distribution of objects in the selected labyrinth (Figure 19).

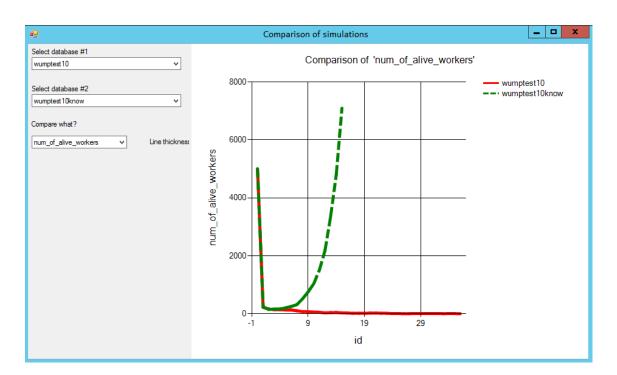


Figure 16: Comparison of two simulation databases.

Selections	Exit	Monitor on/off
Displa	discovered fields of the selected worker	
Displa	discovered fields of all alive workers	
Displa	v discovered fields of a given generation	

Figure 17: Selection menu: here you can select worker specific knowledge and display discovered fields.

125probe2 • Data Sql Diagrams							Selections Exit			M	onitor on/off				
							i 🛛 🔹 1 , összesen: 440384 🕨 🔰 Reload logbook				E M -	€ 1 ,	1 , összesen: 1122 🕨 🔰		
	worker_id	live	energy	loc_wumpus	loc_trap	loc_gold ^	row_id	worker_id	start_position	start_energy	iteratio ^		iteration_id	num_of_alive_workers	gathered_er
1	12		8079		30,19;	47,49;44,1	▶ 0	396	0.1	199	0	<u>۲</u>	0	500	100000
	20		5678		37,0;32,34	47,49;43,4	1	35	0.1	199	0		1	500	99500
1	22		3878		7,44;19,2;	36,7;31,46	2	413	0.1	199	0		2	448	88704
2	27		2678	1,1;2,49;		44,15;10,2	3	🖳 Discovered p	paths visited by v	vorker:20 in labyrin	th: 0	-	- 🗆	×	82937
4	44		7078			47,49;43,4	4			- *					82264
4	48		678	49.44:22.41:	11,48;	47,49;43,4	5								78760
5	55		3478	8,12;41,31;	37,0;6,7;	47,49;36,7	6								79094
(60		5478		30,19;11,48;	47,49;13,1	7								76620
6	56		1278	49,44;41,31;8,	6,7;14,16;	47,49;13,1	8								82592
5	77		1878		37,0;19,2;	31,46;26,1	9								79783
5	79		278	14,14;	19,2;32,34;	47,49;13,3	10								90140
8	88		10078	14,14;	37.0;	47,49;31,4	11								88511
5	92		3879	8,12;	5,1;6,7;	47,49;26,1	12								94896
9	96		3678	14,14;	14,16;19,2	44,15;13,1	13								93669
1	114		2278	49.44:	19,2;11,48;	47,49;43,4	14								97266
	125		4078	1,1;22,41;2,49;	14,16;5,1;	47,49;13,1	15								95875
1	131		4678	2,49;1,1;		47,49;10,2	16					ч			99496
1	138		4478	22,41;	37,0;	43,40;31,4	17								97495
1	144		678	41,31:37,19;2,	5.1:	43,40;34,2	18								104502
1	150		5878		37,0;	47,49;31,4	19								103336
1	157		1278	41.31:37.19;	32,34;32,35;	43.40:31.4	20					1	_		105180
1	168		4678			43,40;13,3	21								102034
1	182		6078		32,35;	47,49;36,7	22								105254
1	196		679	49,44;40,12;8,	6,7;	47,49;43,4	23								104480
1	210		6678	40.12:1.1:2.49:	37.0:	47,49;31,4	24								
1	218		1678	32,25;37,19;	19,2;	44,15;26,1	25							The second	eload lab
	222	M	3078	41,31;		43,40;	26							number_of_wu	mpus wum

Figure 18: Discovered fields (green pixels) by a selected worker in a certain labyrinth. Gold pixels are gold bars, red pixels are traps and grey pixels are wumpuses

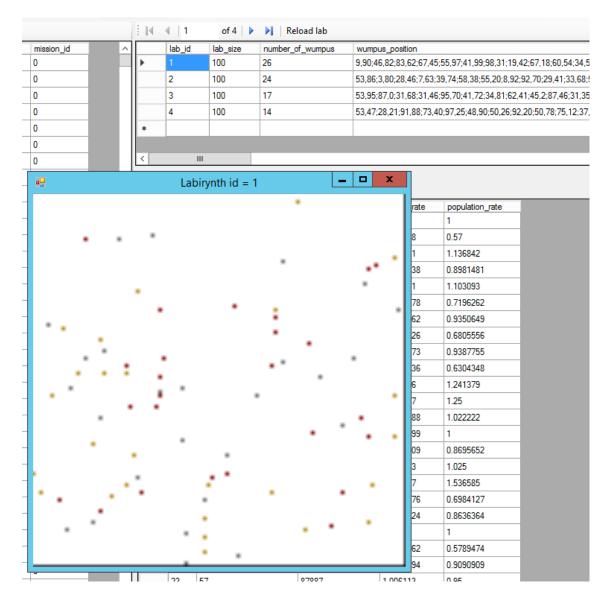


Figure 19: A certain labyrinth with many wumpuses (dark grey points), traps (red points) and gold bars (goldenrod points). Select a labyrinth by clicking with right mouse button on lab datagrid if you wish to see the labyrinth graphically.