# Database Inside

*Database Inside* can be found in the Tools menu in the full version of IBExpert. You can use the IBExpert *Database Inside* feature to analyze and repair databases. (This feature is unfortunately not included in the free IBExpert Personal Edition.)

*Database Inside* reads the database file directly, without a server. This allows extraction of data/metadata from corrupted databases even if it is impossible to do this using a normal connection to the database. The result depends on how heavily the database is corrupted. *Database Inside* processes files in read-only mode so files remain unchanged.

IBExpert also supports Firebird 3 databases as long as they are not encrypted.

Here we have a database, which is corrupt. When attempting to connect to the database, an error message appears which reads: *Bad Checksum error on database page 262*:

IBExpert
nsuccessful execution caused by a system error that precludes successful execution of subsequent statement atabase file appears corrupt (). ad checksum. hecksum error on database page 262.
ОК

It is not even possible to perform a successful backup – even without the Garbage Collection or with or without any other options. In this example, one of the system tables is damaged; so it's a pretty serious problem. Even using gfix to validate the database is not successful.

So, we can either discard the database or use *Database Inside*.

When you start *Database Inside* you are asked to select and subsequently open a database file:

Last update: 2023/10/09 02-ibexpert:02-08-ibexpert-tools-menu:database-inside http://ibexpert.com/docu/doku.php?id=02-ibexpert:02-08-ibexpert-tools-menu:database-inside 20210

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9												
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The selected database is opened and loaded accordingly:

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9       Index Root       0	8	Pointer	12	- Disable using shared cache hie		00000180	00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00				
0       Parter       13       Detables Si, Leber(1)       00	9	Index Root		Database is shutbown		00000100	00 00 00 00 00 00 00 00					
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	3	Index Root				00000290	00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00		~		

*Important*: there is no Firebird server or tool started or involved here in any way. IBExpert's internal structures read and load the database content. This allows you to view and repair databases that are otherwise irreparable.

#### back to top of page

## All pages

The *All pages* page displays a list of database pages in natural order. Page types to be displayed here are customizable on the Options page. Please note that for large databases it is better to disable the display of the *index tree*, *index root* and *blob data* pages in order to optimize memory usage.

Suspicious pages (pages marked as allocated with unknown page type or/and wrong checksum) appear highlighted in **red**.

All Pages	s Statistics	Header	PIPs	TIPs	P
Page	Туре		Re	latio	^
255	Pointer			156	
256	Index Root				
257	Data			5	
258	Index Tree				
259	Data			5	
260	Pointer			157	
261	Index Root				-
262	Data?				
263	Data			6	
264	Data			5	
265	Data			3 5	
266	Index Tree				
267	Pointer			158	
268	Index Root				
269	Data			6	
270	Data			5	
271	Index Tree				
272	Pointer			159	
273	Index Root				
274	Data			5	
275	Data			8	
276	Pointer			160	
277	Index Root				
278	Data			5	
279	Pointer			161	
280	Index Root				

Here we can see that page 262 – just as Firebird has already told us – is corrupt.

When you click through the page types listed on the left, you will see that different information according to page type is displayed. For example, when clicking on the **Database header** page in the *All pages* list, you can view page header information, database properties and flags as hex code, simply by clicking on the item.

Double click on the page or press *Enter* to open the data page in a separate window.

Please note, that when a data page or pointer page is selected, there are three data views in the lower part of the screen: *Columns view*, *Raw data*, *packed* and *Unpacked data*.

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You can read more about data pages and pointer pages in the following articles:

- Pointer Page type 0x04
- Data Page type 0x05
- Pointer page (PTR)
- Data page (DPG)
- Structure of a data page

back to top of page

#### **Statistics**

-

The *Statistics* page contains some useful statistics related to distribution of pages within the database file. Suspicious data (number of allocated pages with undefined/unknown page type and/or wrong checksum) appears highlighted in **red**.

All Pages	Statistics	Header	PIPs	TIPS	Pointer Pages	Extract Data\Me	tadata Options
Page type		4		1	Count	%	Size in Mb
All page	s				380655	100	1486,93
Allocate	d pages				380655	100,00	1486,93
- Undefi	ned				0	0,00	0,00
Databa	se Header				2	0,00	0,01
- Page 1	nventory				12	0,00	0,05
Transa	action Invent	ory			36	0,01	0,14
Pointer	r				74	0,02	0,29
Data					8083	2,12	31,57
- Index F	Root				68	0,02	0,27
Index	Tree				912	0,24	3,56
- Blob D	ata				371448	97,58	1450,97
Genera	ators				2	0,00	0,01
- Write /	Ahead Log				1	0,00	0,00
-Pages	with wrong	checksum			6	0,00	0,02
- Pages	with unknow	vn page ty	pe		17	0,00	0,07
Not alloc	ated page	s			0	0,00	0,00

For further information regarding the individual page types, refer to the Database Technology article, Firebird for the database expert: page types and the IBExpert documentation chapter, Database Statistics.

Definition: WAL - Write Ahead Log

back to top of page

# Header

The *Header* page contains the database header data.

1.5.00

All Pages Statistic Header PPs T	TPs Pointer Pages	Extract Data\Me	tadata Options
Page type	Count	%	Size in Mb
- All pages	380655	100	1486,93
Allocated pages	380655	100,00	1486,93
Undefined	0	0,00	0,00
Database Header	2	0,00	0,01
- Page Inventory	12	0,00	0,05
Transaction Inventory	36	0,01	0,14
Pointer	74	0,02	0,29
Data	8083	2,12	31,57
- Index Root	68	0,02	0,27
Index Tree	912	0,24	3,56
- Blob Data	371448	97,58	1450,97
Generators	2	0,00	0,01
Write Ahead Log	1	0,00	0,00
- Pages with wrong checksum	6	0,00	0,02
- Pages with unknown page type	17	0,00	0,07
Not allocated pages	0	0,00	0,00

Again, when you click through the list on the left, you can see the exact hex code used by Firebird to define this property.

There are a number of interesting articles about the Header Page:

- Database Header Page type 0x01
- Standard database page header
- Firebird for the database expert: Header page (HDR)
- Structure of a header page

and the subject, *Database Properties* is dealt with in detail in the IBExpert chapter, **Database Properties**.

Definition: OIT - Oldest Interesting Transaction

back to top of page

#### PIPs

The *PIPs* (PIP: Page Inventory Pages) page contains list of all PIPs in the database file and information about the allocation of pages.

Property	Value	00000000	01	00	39	30	98	DD	08	00	00	00	00	00	00	00 00	00 0	
1) Page Header		00000010	00	10	0B	90	03	00	00	00	00	00	00	00	65	DD O	00 8	
Database properties		00000020	66	DD	08	00	BD	DD	08	00	00	00	22	01 .	SC 1	D6 00	00	£9
- Page size	4096	00000030	74	66	86	26	00	00	00	00	00	00	00	00	10	00 00	00 0	1 ff
Version of on-disk structure	11 (Firebird)	00000040	00	00	96	00	40	1.F	00	00	01	00	00	00	66	DD OI	00	
Page number of RDB\$PAGES relation	3	00000050	00	00	00	00	00	00	00	0.0	0.0	00	00	00	00	00 00	0.00	
- Page number of next header page	0	00000060	0.5	04	20	47	0.0	00	0.2	78	4.0	28	5.0	44	£1.	74 6		N. (HellDater
Oldest interesting transaction	580965	00000000	44	44	50	5.0	40	61	23	24	50	6 F	66	74	500	44 4	1 6.0	DDI Smawr Safri DBI
<ul> <li>Oldest transaction thought active</li> </ul>	580966	00000070	. 33	12	50	23	60	01	12	12	23	20	00	12.0	36	17 74	06 3	DDISMAPCSOFCIDBI
<ul> <li>Next transaction id</li> </ul>	581005	00000080	93	41	52	99	42	92	92	91	53	95	Sr.	32.	2E	03 0	62	CARDIOBASE_2.00D
Sequence number of file	0	00000090	04	04	67	C5	07	00	00	00	00	00	00	00	00	00 00	00.00	
- Date of creation	29.01.2009	000000A0	00	00	00	00	00	00	00	00	00	00	00	00	00	00 00	00 0	ion mani
Time of creation	17:57:14	000000B0	00	00	00	00	00	00	00	00	00	00	00	00	00	00 00	00 0	
Next attachment id	0	00000000	00	00	00	00	00	00	00	00	00	00	00	00	00	00 00	00 0	
-Event count for shadow synchronization	0	00000000	00	00	00	00	00	00	00	00	00	00	00	00	00	00 00	00 0	
- Implementation number	16	000000E0	00	00	00	00	00	00	00	00	00	00	00	00	00	00 00	00 0	
Update version of ODS	0	000000P0	00	00	00	00	00	00	00	00	00	00	00	00	00	00 00	00 0	
- Update version of ODS at creation	0	00000100	00	00	00	00	00	00	00	00	00	00	00	00	00	00 00	0.00	
Onset of HDK_end in page	150	00000110	00	00	00	00	0.0	00	00	0.0	00	00	00	00	00	00 00	0.00	
Page butters for database cache	8000	00000120	00	00	00	0.0	00	00	00	0.0	0.0	00	00	00	10	00 00	1 00	
Oldest separate of active transactions	EBOOKE	00000120	00	00	00	00	00	00	00	00	00	00	00	00	20	00 0	0.00	
P these	200300	00000130	00	00	00	00	00	00	00	00	00	00	00	00		00 00	00	
L Arthur chadow		00000140	00	00	00	00	00	00	00	00	00	00	00	00		00 00	00	
Enred writes		00000150	00	00	00	00	00	00	00	00	00	00	00	00.	00	00.00	00	
Short-term isumalling		00000160	00	00	00	00	00	00	00	00	00	00	00	00	00	00 00	00 0	
-long-term journaling	ä	00000170	00	00	00	00	00	00	00	00	00	00	00	00	00	00 00	00 0	
Don't calculate checksums	H	00000180	00	00	00	00	00	00	00	00	00	00	00	00	00	00 00	00 0	miimmiim
-Don't reserve space for versions	R	00000190	00	00	00	00	00	00	00	0.0	00	00	00	00	00	00 00	00 0	
- Disable using shared cache file	ñ	000001A0	00	00	00	00	00	00	00	00	00	00	00	00	00	00 00	00 0	
Database is shutdown	ä	000001B0	00	00	00	00	00	00	00	00	00	00	00	00	00	00 00	00 0	
Database SQL dialect 3		000001C0	00	00	00	00	00	00	00	00	00	00	00	00	00	00 00	00 0	
Database is said only		00000100	-	-		-			-			-						

You can read more about PIPs in the following articles:

- Firebird for the Database Expert: Episode 2 Page Types
- Firebird Internals: Page Inventory Page

back to top of page

#### TIPs

The TIPs (TIP: transaction inventory pages) page contains list of all TIPs in the database.

All Pages	Statistics I	Header PTF	TUS	ointer Pages	Extract Data\Metadata	Options	
Page Index /	Next PIP			Page Index	Page Type		Allocated
1	3260	7		358688	Blob Data		×
32607	6521	5		358689	Blob Data		
65215	9782	3		358690	Blob Data		×
97823	13043	1		358691	Blob Data		
130431	16303	9		358692	Blob Data		
163039	19564	7		358693	Blob Data		
195647	22825	5		358694	Blob Data		
228255	26086	3		358695	Blob Data		
260863	29347	1		358696	Blob Data		18
293471	32607	9		358697	Blob Data		CH I
326079	35868	7		358698	Blob Data		×
358687	39129	5		358699	Blob Data		
				358700	Blob Data		
				358701	Blob Data		×
				358702	Blob Data		
				358703	Blob Data		
				358704	Blob Data		×
				358705	Blob Data		
				358706	Blob Data		×
				358707	Blob Data		100

You can read more about TIPs in the following articles:

Firebird for the database expert: Transaction Inventory Page (TIP) Transaction Inventory Page - type 0x03

back to top of page

## **Pointer pages**

The *Pointer pages* page contains list of all pointer pages for each relation in the database.

You can read more about PTRs in the following articles:

Firebird for the database expert:: Pointer page (PTR) Pointer Page - type 0x04

back to top of page

#### Extract data/metadata

The *Extract Data/Metadata* page allows you to extract data and/or metadata directly from the database file. Metadata/data can be extracted into a set of SQL script files or into a new database (a working server instance is necessary in this case). You can extract just metadata, just data or both. It is important to specify the correct Firebird server version and SQL dialect. And don't forget to specify a *Target directory* if you are exporting to script files.

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Data/metadata extract options
Extract into Extract what
New database  Metadata and data of selected tables
Target server version
Firebird 2.5 SQL Dialect 3
New database options
Database connection string
localhost:C:\employee_repair.fdb
Client library
C:\Program Files (x86)\Firebird\Firebird_2_5\bin\fbclient.dll
User name SYSDBA
Password *******
Page size 4096
Default charset WIN1252 -
✓ Use EXECUTE BLOCK for better performance
✓ Use short INSERT (without list of field names) if possible
✓ Drop target database if exists

In our example here we've uses the relevant Embedded Firebird client. We could of course use a normal Firebird client; this would then run as a client via a remote connection.

To speed up the whole thing we've checked the option, Use *EXECUTE BLOCK* for better performance and – just in case the database already exists, we've checked the option, *Drop target database if exists*.

The option *Use short INSERT if possible option* generates a short version of INSERT - without the list of columns - as opposed to the long INSERT. This allows you to put more statements in a block and improve performance.

You can select/unselect all data tables simultaneously from the context menu of the data tables list.

Now simply click *Extract data/metadata* in the bottom right-hand corner to save as much of your database as is possible!

IBExpert now opens the Firebird database in binary form. We are not touching any Firebird instance at all. This way we have the possibility to bypass all of Firebird's security mechanisms and internal structures. IBExpert protocols the export process, detailing which data objects for example, cannot be recreated without errors.

This is vital, in order to determine which parts of the database still function correctly and where any problems lie.

All Pages	Statistics Header PIPs TIPs Pointer Pages Output	Extract Data\Metadata	Errors: 23	Options
Creating	procedure SPGETIFNSUR Successful.			
Creating	procedure SPGETLAKTSTSDR Successful.			
Creating	procedure SPGETLBOMSOR Successful.			
Creating	procedure SPGETLPSORS Successful.			
Creating	procedure SPGETL2EKGSUR Successful.			
Creating	procedure SPGETPATTRADATSUR Successful.			
Creating	procedure SPGETPATTRKDATSUR Successful.			
Creating	procedure SPGETSUR FAILED!			
Creating	procedure SPGEISURMUL FAILED!			
Creating	procedure SPGETSYSPARSID Successful.			
Creating	procedure SPGEISYSPARSOR Successful.			
Creating	procedure SPGETTEXT Successful.			
Creating	procedure SPGEIUBEKGSUR Successful.			
Creating	procedure SPGEIUREKGNKSUR Successful.			
Creating	procedure SPGETUREKGSUR Successful.			
Creating	procedure SPGETURTAUSWSUR Successful.			
Creating	procedure SPGETURTRAINASUR Successful.			
Creating	procedure SPGETURTRAINSUR Successful.			
Creating	procedure SPGETURYERGSUR Successful.			
Creating	procedure SPGETUTRLIST Successful.			
Creating	procedure SPGETUTRLISTOHNEPAT Successful.			
Writing	triggers			
Creating	trigger TBBUTBFATEREIGNISUPD Successful.			
Creating	trigger TRAI_TELZEKGPARAUFN D Successful.			
Creating	crigger TRAIBUFARAUFNPAIUPD FAILED!			
Creating	crigger TRAIBUIREDATOPDFAT Successful.			
Creating	Crigger TRAILAKTATPARADFNPAIDPD Successful			
Creating	trigger TRAILBOMPARADENPATUPD Successful.			
Creating	TRIANS TONTOTODO CONTRACTO			

The metadata objects are created, and this metadata is displayed by IBExpert as a summarized evaluation at the end. IBExpert shows you where it was not possible to execute certain items, for example which metadata objects could not be processed correctly.

All commands executed here are included in the IBE\$DBINSIDE\$ERRORS table. This can be opened separately from IBExpert's Database Explorer, once you have registered the repaired database for use in IBExpert.

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All Pages Statistics Header PIPs TIPs Pointer Pages Output Extract Data/	Metadata Errors: 52 Option	\$			
	48 e Erroneous statement	rror(s) occu s and error r	red while ex nessages ha in order of	ecuting DML/DDL statements. ive been stored in IBE\$DBINSIDE\$ERRORS table appearance.	
# Message	Data page	Record #	Relation ID	Column #	
6 violation of FOREIGN KEY constraint **.	0				
7 Invalid token.	0				
8 Invalid token.	0				
9 Invalid token.	0				
10 Invalid token.	0				
11 Column does not belong to referenced table.	0				
12 Invalid token.	0				
13 Column does not belong to referenced table.	0	1			
14 Column does not belong to referenced table.	0				
15 Invalid token.	0				
16 Invalid token.	0				
17 Invalid token.	0				
18 Invalid token.	0				
19 Invalid token.	N 0	1			
20 Invalid token.	L3 0				
21 Invalid token.	0				
22 Invalid token.	0				
23 Invalid token.	0				
24 Invalid token.	0				
25 Invalid token.	0				
26 Invalid token.	0	)			
27 Invalid token.	0				
28 Invalid token.	0				
29 Invalid token.	0				
30 Invalid token.	0				
Error additional info					
Invalid token.					
invalid request BLR at offset 21.					
function UDFNEWSUR_ is not defined.					
module name or entrypoint could not be found.					
CREATE TRIGGER TRBITBLZEKGHESSURCRUPD_ FOR TBLZEKGHES_ ACTIVE BEFORE INSERT POSITION 0					
as declare mariable materian marchan (20) -					
begin					

You can then normally trace and carry out any necessary repair work, for example going to the indicated location in certain objects, or trace to, for example, certain UDFs in the UDF library that are referred to here in our example, which are not usable.

You can see quite clearly the list of operations that were successful along with those that were unsuccessful:

All Pages	Statistics	Header	PIPs	TIPs	Pointer Pages	Output	Extract Data\Metadata	Errors: 52	Options
Creating	trigger	TRAU_TB	UEREIO	SNIS_:	2 Success	ful.			
Creating	trigger	TRAULAK	TATPAR	RAUFNI	PATUPD S	uccessfu	11.		
Creating	trigger	TRAUTEB	LOBS_0	D 1	FAILED!				
Creating	trigger	TRAUTBI	PNPARA	AUFNP	ATUPD Su	ccessful			
Creating	trigger	TRAUTBL	BDMPAR	RAUFN	0 Succes	sful.			
Creating	trigger	TRAUTEL	ZEKGP	ARAUFT	UPDPAT	Successi	ul.		
Creating	trigger	TRAUTBP	ATEREI	IGNIS	UPDUER B	AILED!			
Creating	trigger	TRAUTBP	ATIENT	TEREIO	GNIS FAI	LED!			
Creating	trigger	TRAUTBU	EREIG	ISUP	DSIGPARAUSW	Suco	essful.		
Creating	trigger	TRAUTBU	PARAU	FNUPDI	PAT Suco	essful.			
Creating	trigger	TRAUTEU	TRKDAT	PATU	PD Succe	ssful.			
Creating	trigger	TRBDTBB	LOBS 0	D 1	FAILED!				
Creating	trigger	TRBDTBP	ATEREI	IGNIS	0 Succes	sful.			
Creating	trigger	TRBI TB	LZEKG	PARAU	FN 0 FAIL	ED!			
Creating	trigger	TRBI TB	LZEKG	PARAUS	SW 0 FAIL	ED!			

You can then register the repaired database for use in IBExpert.

Learn more about extracting metadata in the IBExpert documentation chapter, Extract metadata.

back to top of page

#### Options

On the *Options* page you can select the types of pages to be listed in All pages page.

Database Inside: C:\Firebird 30\fb30w32\examples\empbuild\EMPLOYEE.FDB								
i 📂								
All Pages	Statistics	Header	PIPs	TIPs	Pointer Pages	Extract Data Wetadata	Options	
Show following pages in the "All pages" list						Run "Open da	tabase file" dialog immediately after the	Database Inside starts
✓ Database header page;								
Page inventory pages								
Transaction inventory pages								
Pointer pages								
V Data pages								
Index pages								
Index root pages								
biob data pages								
✓ Generator pages								
vinte anead log pages								
Pages marked as not allocated								
✓ Undefined pages (page type = 0								
<ul> <li>Pages with unknown page type</li> </ul>								

Please note that for large databases it is better to disable the display of the *index tree*, *index root* and *blob data* pages in order to optimize memory usage.

back to top of page

## **Current limitations**

- only single-file databases are supported at the moment.
- InterBase® databases with object names' length > 31 chars are not supported yet.
- the *Database Inside* feature has been tested with Firebird 1.5-2.5 databases created with Firebird for Windows.

## **Further reading**

- Database corruption
- Database Validation

Last update: 2023/10/09 20:10 20:

- Tracking down crashes on Linux
- Tracking down crashes on Win32 systems
- How to analyze and repair a corrupted database
- Preventing data loss
- Database repair

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Last update: 2023/10/09 20:10