



YOSHINORI MATSUNOBU'S BLOG

THURSDAY, OCTOBER 10, 2013

Making full table scan 10x faster in InnoDB

At MySQL Connect 2013, I talked about how we used MySQL 5.6 at Facebook, and explained some of new features we added to our Facebook MySQL 5.6 source tree. In this post, I'm going to talk about how we made full table scan faster in InnoDB.

FASTER FULL TABLE SCAN IN INNODB

In general, almost all queries from applications are using indexes, and reading very few rows (0..1 on primary key lookups and 0..hundreds on range scans). But sometimes we run full table scans. Typical full table scan examples are logical backups (mysqldump) and online schema changes (SELECT ... INTO OUTFILE).

We take logical backups by mysqldump at Facebook. As you know MySQL offers both physical and logical backup commands/utilities. Logical backup has some advantages against physical backup. For example:

- Logical backup size is much smaller. 3x-10x size difference is not uncommon.
- Relatively easier to parse backups. On physical backup, if we can't restore a database by some serious reasons such as checksum failure, it is very difficult to dig into InnoDB internal data structures and fix corruptions. We trust logical backups rather than physical backups

Major drawbacks of the logical backup are that full backup and full restore are much slower than physical backup/restore.

The slowness of full logical backup often causes problems. It may take very long time if database size grows a lot and tables are fragmented. At Facebook, we suffered from mysqldump performance problem that we couldn't finish full logical backup within reasonable amount of time on some HDD and Flashcache based servers. We knew that InnoDB wasn't efficient at full table scan because InnoDB did not actually do sequential reads, but did random reads mostly. This was a known issue for long years. As database storage capacity has been growing, the slow full table scan issue has been getting serious to us. So we decided to enhance InnoDB to do faster sequential reads. Finally our Database Engineering team implemented "Logical Readahead" feature in InnoDB. With logical readahead, our full table scan speed improved 9~10 times than before under usual production workloads. Under heavy production workloads, full table scan speed became 15~20 times faster.

Issues of full table scan on large, fragmented tables

When doing full table scan, InnoDB scans pages and rows by primary key order. This applies to all InnoDB tables, including fragmented tables. If primary key pages (pages where primary keys and rows are stored) are not fragmented, full table scan is pretty fast because reading order is close to physical storage order. This is similar to reading files by OS command (dd/cat/etc) like below.

```
# dd if=/data/mysql/dbname/large_table.ibd of=/dev/null bs=16k iflag=direct
```

You may find that even on commodity HDD servers, you can read more than 100MB/s multiplied by "number of drives" from disks. Over 1GB/s is not uncommon.

Unfortunately, in many cases primary key pages are fragmented. For example, if you need to manage user_id and object_id mappings, primary key will be (user_id, object_id). Insert ordering does not match with user_id ordering, so new inserts/updates very often cause page splits. New split pages will be allocated at far from current pages. This means pages get fragmented.

If primary key pages are fragmented, full table scan becomes very slow. Fig 1 illustrates the problem. After InnoDB reads leaf page #3, it has to read page #5230, and after that it has to read page #4. Page #5230 is far from page #3 and #4, so disk read ordering becomes almost random, not sequential. It is very well known that random reads on HDD is much slower than sequential reads. One very effective approach to improve random reads is using SSD, but per-GB cost on SSD is still more expensive than HDD so using

ABOUT ME



YOSHINORI MATSUNOBU

I am a database engineer at Facebook. Before joining Facebook, I was a principal database and infrastructure architect at DeNA. My primary responsibility at DeNA was to make our database infrastructure more reliable, faster and more scalable. Before joining DeNA, I worked at MySQL/Sun/Oracle as a lead MySQL consultant in APAC for four years. You can contact me on Yoshinori.Matsunobu_at_gmail.com (replace _at_ with @).

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SSD is not always possible.

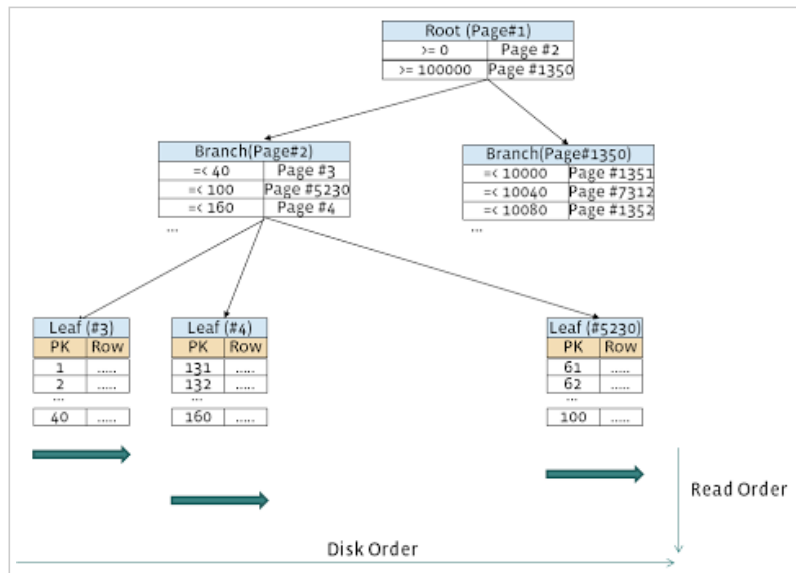


Fig 1. Full table scan is not actually doing sequential reads

Does Linear Read Ahead really help?

InnoDB supports prefetching feature called "Linear Read Ahead". With linear read ahead, InnoDB reads an extent (64 consecutive pages: 1MB if not compressed) at one time if N pages are accessed sequentially (N can be configured by `innodb_read_ahead_threshold` parameter, default is 56). But actually this does not help so much. One extent (64 pages) is very small range. For most large fragmented tables, next page does not exist in the same extent. See above fig 1 for example. After reading page#3, InnoDB needs to read page#5230. Page#3 does not exist in the same extent as #5230, so linear read ahead won't help here. This is pretty common case for large fragmented tables. That's why Linear read ahead does not help much to improve full table scan performance.

Optimization approach 1: Physical Read Ahead

As described above, the problem of slow full table scan was because InnoDB did mostly random reads. To make it faster, making InnoDB do sequential reads was needed. The first approach I came up with was creating an UDF (Use Defined Function) to read ibd file (InnoDB data file) sequentially. After executing the UDF, pages in the ibd file should be within InnoDB buffer pool, so no random read happens when doing full table scan. Here is an example usage.

```
mysql> SELECT buf_warmup ("db1", "large_table"); /* loading into buf pool */
mysql> SELECT * FROM large_application_table; /* in-memory select */
```

`buf_warmup()` is a udf that reads entire ibd file of database "db1", table "large_table". It takes time to read the entire ibd file from disk, but reads are sequential so much faster than random reads. When I tested, I could get ~5x overall faster time than normal linear read ahead.

This proved that sequentially reading ibd files helped to improve throughput, but there were a couple of disadvantages:

- If table size is bigger than InnoDB buffer pool size, this approach does not work
- Reading entire ibd file means that not only primary key pages, but also secondary index pages and unused pages have to be read and cached into InnoDB buffer pool, even though only primary key pages are needed for full table scan. This is very inefficient if you have many secondary indexes.
- Applications have to be changed to call UDF.

This looked "good enough" solution, but our database engineering team came up with a better solution called "Logical Read Ahead", so we didn't choose UDF approach.

Logical Read Ahead

Logical Read Ahead (LRA) works as below.

1. Reading many branch pages of the primary key
2. Collecting leaf page numbers

3. Reading many (configurable amount of) leaf pages by page number order (mostly sequential disk reads)
4. Reading rows by primary key order (same as usual full table scan, but buffer pool hit rate should be very high)

This is illustrated at fig 2 below.

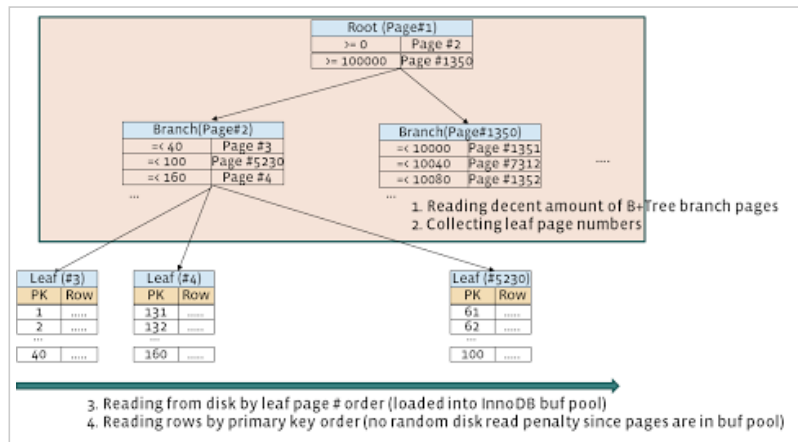


Fig 2: Logical Read Ahead

Logical Read Ahead (LRA) solved issues of Physical Read Ahead. LRA enables InnoDB to read only primary key pages (not reading secondary index pages), and to prefetch configurable number of pages (not entire table) at one time. And LRA does not require any SQL syntax changes.

We added two new session variables to make LRA work. One is "innodb_lra_size" to control how many MBs to prefetch leaf pages. The other is "innodb_lra_sleep" session variable to control how many milliseconds to sleep per prefetch. We tested around 512MB ~ 4096MB prefetch size and 50 milliseconds sleep, and so far we haven't encountered any serious (such as crash/stall/inconsistency) problem. These session variables should be set only when doing full table scan. In our case, mysqldump and some utility scripts (i.e. online schema change tool) turn logical read ahead on.

Submitting multiple async I/O requests at once

Another performance issue we noticed was that i/o unit size in InnoDB was only one page, even if doing readahead. 16KB i/o unit size is too small for sequential reads, and much less efficient than larger I/O unit size.

In 5.6, InnoDB uses Linux Native I/O (aio) by default. If submitting multiple consecutive 16KB read requests at once, Linux internally can merge requests and reads can be done efficiently. But unfortunately InnoDB submitted only one page i/o request at once. I filed a bug report #68659. As written in the bug report, on modern HDD RAID 1+0 environment, I could get more than 1000MB/s disk reads by submitting 64 consecutive pages requests at once, while I got only 160MB/s disk reads by submitting one page request. To make Logical Read Ahead work better on our environments, we fixed this issue. On our MySQL, InnoDB submits many more page i/o requests before calling io_submit().

Benchmark

In both cases, our production tables (fragmented tables) were used.

1. Full table scan on pure HDD (basic benchmark, no other workload)

Table size	Without LRA	With LRA	Improvement
10GB	10 min 55.00 sec	1 min 15.20 sec	8.71x
50GB	52 min 44.42 sec	6 min 36.98 sec	7.97x

2. Online schema change under heavy workload

Table size	Without LRA	With LRA	Improvement
1GB	7 min 33 sec	24 sec	18.8x

* dump time only, not counting data loading time

Source code

All of our enhancements are available at GitHub.

- Logical read ahead implementation : diff
- Submitting multiple i/o requests at once : diff
- Enabling logical read ahead on mysqldump : diff

Conclusion

InnoDB was not efficient for full table scan, so we fixed it. We did two enhancements, one was implementing logical read ahead, the other was submitting multiple async read i/o requests at once. We have seen 8 to 18 times performance improvements on our production tables, and this has been very helpful to reduce our backup time, schema change time, etc. I hope this feature will be supported in InnoDB by Oracle officially, or at least by major MySQL fork products.

POSTED BY YOSHINORI MATSUNOBU
LABELS: 5.6, INNODB, MYSQL

158 COMMENTS:



Clay Ferguson said...

Dude did you just implement a Bayer Tree in database tables ?

OCTOBER 10, 2013 AT 5:16 PM



sunbains said...

The second diff doesn't look right, see:

```
+ errno = -total_submitted;
```

Earlier in the code you have:

```
+ total_submitted += io_submit(array->aio_ctx[i], count,
+ &(array->pending[iocb_index]));
```

What if io_submit() fails after the 1st iteration?

OCTOBER 10, 2013 AT 6:38 PM



Sunny Bains said...

In the third diff you have:

```
+#ifdef LINUX_NATIVE_AIO
+ os_aio_linux_dispatch_read_array_submit();
+#endif
```

What happens if LINUX_NATIVE_AIO is not defined? Did I miss the IO call?

OCTOBER 10, 2013 AT 8:15 PM



Rongrong Zhong said...

Sunny: You are right, it won't set the errno correctly if io_submit fail in later iterations. Thanks for pointing that out!

OCTOBER 10, 2013 AT 9:49 PM



Tom K said...

Great article! Really impressed with Sunny's comment too.

OCTOBER 11, 2013 AT 5:47 AM



Tim Callaghan said...

Yoshinori: How does this improvement in full table scan performance for your mysqldumps affect the other running workload on the server? I assume that bringing the data 18x faster into the

InnoDB cache would have a measurable impact.

OCTOBER 11, 2013 AT 8:27 AM



Justin Swanhart said...

Tim that is what innodb_old_blocks_time and innodb_old_blocks_pct are for. They are meant to prevent FTS from "blowing out" good blocks in the BP.

OCTOBER 11, 2013 AT 9:49 AM



Justin Swanhart said...

That being said, buffer pool pinning is probably something else that should be added. This would keep some objects in the BP no matter what, like important lookup tables.

OCTOBER 11, 2013 AT 9:51 AM



Tim Callaghan said...

Justin, fair enough. But I was hoping to see some actual evidence in either direction from Yoshinori. I don't trust anything without measurement.

OCTOBER 15, 2013 AT 10:25 AM



Yoshinori Matsunobu said...

Tim, we set innodb_old_blocks_time and innodb_old_blocks_pct so that pages read by backups are quickly evicted.

Another important point I should note is that we use flashcache, and we do some optimizations here. In general, cache miss in InnoDB is not so much painful if cache hits in flashcache, because flash is fast. It's very painful if cache misses in flashcache, because hdd is slow. On backups, when reading ibd file from hdd (cache miss), our mysqld does not write to flash, but directly caches into buffer pool. This means existing cached pages in flash(flashcache) are not evicted. This is more important optimization for us.

OCTOBER 15, 2013 AT 5:01 PM



Tim Callaghan said...

Thanks for the explanation. Well done on this clever optimization!

OCTOBER 16, 2013 AT 1:45 PM



Rock said...

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OCTOBER 22, 2013 AT 6:41 AM



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OCTOBER 24, 2013 AT 10:07 PM



Web Designing Bangalore said...

Never the less ,you efforts are very marvelous , wonderful. Thanks for useful information.
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OCTOBER 24, 2013 AT 10:08 PM



zinavo shankar said...

Thanks for sharing the information with us.Its really good information.
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NOVEMBER 29, 2013 AT 9:31 PM



Fred Duffler said...

I'd like to thank you for tables and figures. <http://online-essay-writer.org/> It was very useful paper for me indeed.

NOVEMBER 30, 2013 AT 1:19 PM



Manoranjan Sahoo said...

Nice tutorial, thanks for share this post. I hope peoples are really help after reading this blog.
Website designing company India

DECEMBER 6, 2013 AT 9:22 PM



Manoj Kusshwaha said...

Nice article got a good knowledge you have

MARCH 10, 2014 AT 9:35 AM



Matthew Corgan said...

Have you looked into the possibility of actually defragmenting the table, either in background threads or during writes?

MARCH 29, 2014 AT 2:47 PM



rakesh said...

Great Information,thanks a lot for sharing this interesting article,really its very impressive..
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APRIL 10, 2014 AT 2:47 AM



Sudha S said...

very informative article, thank you for sharing this great article...

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APRIL 10, 2014 AT 10:08 PM



Sagheer said...

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APRIL 20, 2014 AT 12:19 AM



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MAY 19, 2014 AT 10:27 PM



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JUNE 15, 2014 AT 10:17 PM



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JUNE 24, 2014 AT 11:26 PM



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JULY 9, 2014 AT 12:08 AM



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OCTOBER 22, 2014 AT 11:32 PM



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JANUARY 21, 2016 AT 12:38 AM



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VIMAX
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Unknown said...

Awesome Blog. Informative Post.

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FEBRUARY 16, 2016 AT 10:51 AM



Ashoka Liviano said...

Great and Informative Blog.Thanks for sharing with us.
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FEBRUARY 17, 2016 AT 10:12 PM



Sobha Gateway Of Dreams said...

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MARCH 9, 2016 AT 10:23 PM



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MARCH 16, 2016 AT 6:36 AM



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MARCH 21, 2016 AT 1:32 AM



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MARCH 24, 2016 AT 2:36 AM



Khalid Baid said...

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Bridal Gowns Collection

LADIES BLAZER STYLES OUTFITS

MEHNDI DRESS DESIGNS

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classic lawn suits

mix eid dresses
midsummer kurta
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MARCH 31, 2016 AT 8:21 PM



Khalid Baid said...

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ball garments
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MEN WEAR WEDDING SHERWANI
Jewelry Women Wear
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Zainab Chottani Pretty Suits
STYLISH SUNGLASSES DESIGNS
FROCKS DESIGNS FASHION
LONG GOWNS OUTFITS FASHION
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MARCH 31, 2016 AT 8:22 PM



Pavitraa Fashion said...

I like your blog, mind power use and developing web designing on table scan faster. Very beautiful designer clothing Bollywood Sarees !!

MARCH 31, 2016 AT 10:42 PM



Pushpa Anjali said...

It's really a nice and helpful piece of information. I'm glad that you shared this helpful info with us. Please keep us informed like this.

G Corp Icon Bangalore
Assetz Marq Bangalore

APRIL 10, 2016 AT 10:12 PM



Sare Homes said...

How to create a table in DB.
Sare Homes Chennai

APRIL 10, 2016 AT 10:38 PM



rakesh said...

good information
website design in bangalore
website design in bangalore
web design bangalore
website design bangalore web design in bangalore

APRIL 15, 2016 AT 6:05 AM



Pushpa Anjali said...

It's really a nice and helpful piece of information. I'm glad that you shared this helpful info with us. Please keep us informed like this.

Assetz Marq

APRIL 19, 2016 AT 10:33 PM



Anusha Gona said...

Nice Blog...

Bhartiya City Nikoo Homes Thanisandra Bangalore
LnT Raintree Boulevard Hebbal bangalore

Vertex Panache

APRIL 22, 2016 AT 12:13 AM



Anusha Gona said...

Nice Blog...

Bhartiya City Nikoo Homes Thanisandra Bangalore
LnT Raintree Boulevard Hebbal bangalore

Vertex Panache

APRIL 22, 2016 AT 1:30 AM



Mai Doan said...

This topic is interesting. This information is very useful to me. I hope there will be many articles or like this article. Thank you for sharing

The head soccer synthetic head soccer unblocked games famous. on head soccer you could be playing head soccer unblocked , Big Head Soccer or Big Head Football . Big Head Soccer Big Head Football are games is our top. Rejoice with Big Head Soccer Big Head Football Big Head Soccer Big Head Football offline

APRIL 22, 2016 AT 8:29 AM



Anusha Gona said...

Its Really great blog...thanks for sharing
Salarpuria Sattva Laurel Heights

Salarpuria Sattva Divinity

APRIL 25, 2016 AT 1:30 AM



Anusha Gona said...

Its Great Blog...
Salarpuria Sattva Laurel Heights
Salarpuria Sattva Divinity

APRIL 25, 2016 AT 1:31 AM



cap vision said...

its Awesome blog Web design

MAY 4, 2016 AT 5:16 AM



Bangalore Web Guru said...

very nice blogs!!! i have to learning for lot of information for this sites...Sharing for wonderful information.Thanks for sharing this valuable information to our vision. You have posted a trust worthy blog keep sharing.

Web Designing Company Bangalore

MAY 5, 2016 AT 2:42 AM



Godrej Eternity said...

Oracle DB is Better.

Godrej Eternity Bangalore

MAY 6, 2016 AT 11:21 PM



Pushpa Anjali said...

Great Blog

Pacifica Hill Crest

MAY 24, 2016 AT 2:38 AM



Pushpa Anjali said...

Your blog is very informative. Nice post, thanks for sharing with us. Check out our latest pre launch projects.

Prestige Song Of The South

Assetz Marq Bangalore

Prestige Lake Ridge Bangalore

Prestige Lakeside Habitat Bangalore

Goyal Orchid Whitefield

MAY 25, 2016 AT 2:14 AM



Manndola Fuzail said...

Very good article, I must say thanks for sharing this very interesting and quite education blog with us. Appreciate your work, I will also share this blog with my Facebook and twitter friends. Keep it up good going.

Check out my site also, visit @ <http://www.manndola.com>

JUNE 1, 2016 AT 4:42 AM



Mana Foliage Villas said...

Great and Informative Blog.Thanks for sharing with us.

2 BHK Apartments in Beeramguda Hyderabad

JUNE 9, 2016 AT 9:56 PM



Rohit P said...

very good information on this page

good keep it up

Learn seo with best domain experts , reach us seo training in bangalore

JUNE 15, 2016 AT 1:09 AM



Pushpa Anjali said...

Nice Blog

Indian Real Estate Community

Pacifica Hill Crest

Assetz 63 Degree East

JUNE 15, 2016 AT 11:21 PM



akmal niazi khan said...

Programming is very interesting and creative thing if you do it with love. Your blog code helps a lot to beginners to learn programming from basic to advance level. I really love this blog because I learn a lot from here and this process is still continuing.

Love from Pro Programmer

JUNE 18, 2016 AT 1:13 PM



Nguyễn Quỳnh said...

Good read. Thanks for sharing it!

Máy lạnh Reetech

Máy lạnh Samsung

Máy lạnh Aikibi

Máy lạnh Nagakawa

Máy lạnh Midea

JUNE 20, 2016 AT 7:53 PM



L said...

OBAT SINUSITIS

OBAT SINUSITIS

OBAT SINUSITIS

OBAT SINUSITIS

JUNE 20, 2016 AT 9:50 PM



L said...

OBAT SINUSITIS

OBAT SINUSITIS

OBAT SINUSITIS

OBAT SINUSITIS

OBAT SINUSITIS

JUNE 20, 2016 AT 9:51 PM



L said...

OBAT SINUSITIS

OBAT SINUSITIS

OBAT SINUSITIS

OBAT SINUSITIS

OBAT SINUSITIS

JUNE 20, 2016 AT 9:52 PM



Mana Foliage Villas said...

Great and Informative Blog.

2 BHK flats for sale in Beeramguda Hyderabad

JUNE 20, 2016 AT 11:22 PM



Pushpa Anjali said...

Nice Blog

Prestige Lakeside Habitat

JUNE 21, 2016 AT 11:05 PM



Pushpa Anjali said...

Nice Blog

Prestige Lake Ridge Bangalore

Prestige Lakeside Habitat

Prestige Kew Gardens

JUNE 24, 2016 AT 11:58 PM



Pooja Sharma said...

ts a wonderful thought. I like it. Thank you so much for sharing us this information. website designing in jalandhar

JULY 11, 2016 AT 12:02 AM



Mohan krishna said...

good information

JULY 14, 2016 AT 1:26 AM



Minh Vương said...

chữa thoát vị đĩa đệm
chữa thoát vị đĩa đệm ở Hà Nội
triệu chứng thoát vị đĩa đệm
nguyên nhân thoát vị đĩa đệm

JULY 14, 2016 AT 8:08 AM



WHTL said...

I would like to say thanks for your sharing this useful information. Nice post keep it up. Hope to see you next post again soon.

With Regards,

Website Development Company in Bangalore
Ecommerce Website Development

JULY 18, 2016 AT 11:43 PM



Brock Plemel said...

I think you can make a Good business deal with that. Free websites

JULY 20, 2016 AT 4:50 AM



INCOR ONE CITY said...

oracle db is good.

Incor One City Hyderabad

JULY 22, 2016 AT 1:57 AM



Amber minds said...

Nice article with informative ,thanks for sharing....!
web designing bangalore

JULY 27, 2016 AT 10:40 PM



Agaricpro Backlink said...

Thanks for your sharing. We feel very pleased about that. You should also try their best games with our free today to get the sense of fun that brings. Thank you!

Mengenali Tipes

Terjauh dari Tipes

Pencegahan Tipes

Apa Itu Tipes.?

JULY 29, 2016 AT 1:00 AM



Goyal Orchid said...

Nice Blog....Thanks for sharing the imformation

Goyal orchid in whitefield

Mantri Energia Bangalore

JULY 29, 2016 AT 10:36 PM



Goyal Orchid said...

Nice Blog....Thanks for sharing the imformation

Goyal orchid in whitefield

Mantri Energia Bangalore

JULY 29, 2016 AT 10:36 PM

Wholesale Box said..



Ladies clothings Online Wholesaler

Kurtis Wholesale

JULY 30, 2016 AT 5:05 AM



Goyal Orchid said...

Nice Blog....Thanks for sharing the imformation

Goyal orchid in whitefield

Mantri Energia Bangalore

JULY 30, 2016 AT 5:25 AM



Goyal Orchid said...

Nice Blog....Thanks for sharing the imformation

Goyal orchid in whitefield

Mantri Energia Bangalore

JULY 30, 2016 AT 5:25 AM



Poorvi Studios said...

Your post is just outstanding! thanx for such a post,its really going great and great work.You have provided great knowledge about the Website Designing services in Bangalore | Brochure Designing in Bangalore.

AUGUST 1, 2016 AT 4:23 AM



Mantri Energia said...

Nice blog and thanks for sharing the post.

Mantri Energia Bangalore

Goyal Orchid Whitefield Bangalore

AUGUST 1, 2016 AT 10:39 PM



OnlySupermarket hyderabad said...

oracle DB is good.

online Grocery Shopping Hyderabad

AUGUST 10, 2016 AT 3:37 AM



Madhu said...

A very awesome blog post. We are really grateful for your blog post.Thanks for such post and please keep it up. Great work.

Prestige Lake Ridge Bangalore

Prestige Lakeside Habitat

Prestige Kew Gardens

Prestige High Fields

AUGUST 11, 2016 AT 2:55 AM



Pushpa Anjali said...

Nice Blog

Prestige Lake Ridge Bangalore

Prestige Lakeside Habitat

Prestige Kew Gardens

AUGUST 11, 2016 AT 2:59 AM



Agaric Pro said...

Great post i must say and thanks for the information. Education is definitely a sticky subject.

However, is still among the leading topics of our time.

Sinusitis | Sinusitis | Sinusitis | Sinusitis | Sinusitis | Sinusitis | Sinusitis | Sinusitis | Sinusitis |

Hernia | Hernia | Hernia | Hernia | Penyebab Hidrokel | Kenali Hidrokel | Atasi Hidrokel |

Sembuhkan Hidrokel | Demam Berdarah | Demam Berdarah | Demam Berdarah | Demam Berdarah

AUGUST 13, 2016 AT 12:56 AM



Digital Mantra said...

Digitalmantra a leading web design, SEO company in Delhi NCR helps your website to rank high. Hire us for Ethical SEO & **Web Design/Development**. SEO Packages.

AUGUST 13, 2016 AT 2:17 AM



Girija Marvel said...

Nice Blog...Thanks for sharing your information.

" Girija Marvel Hyderabad

AUGUST 13, 2016 AT 4:33 AM



Prestige High Fields said...

Thanks for Sharing Your Information.

Prestige High Fields

AUGUST 15, 2016 AT 11:12 PM



dadang sulaeman said...

Very good idea you've shared here, from here I can be a very valuable new experience. all things that are here will I make the source of reference, thank you friends.

OBAT AMBEIEN

OBAT AMBEIEN

OBAT AMBEIEN

OBAT AMBEIEN

AUGUST 18, 2016 AT 1:05 AM



dadang sulaeman said...

I think reading the article on the web that is very useful especially in this website:

OBAT AMBEIEN

OBAT AMBEIEN

OBAT AMBEIEN

OBAT AMBEIEN

AUGUST 18, 2016 AT 1:06 AM



dadang sulaeman said...

OBAT AMBEIEN

OBAT AMBEIEN

OBAT AMBEIEN

OBAT AMBEIEN

Nice article guys , im waiting update the next article .

AUGUST 18, 2016 AT 1:07 AM



Agaricpro 53 said...

Thanks for your sharing. We feel very pleased about that. You should also try their best games with our free today to get the sense of fun that brings. Thank you!

Obat Asma Untuk Anak

AUGUST 19, 2016 AT 8:05 PM



Bangalore Web Guru said...

The blog was absolutely fantastic! Lot of great information which can be helpful in some or the other way. Keep updating the blog, looking forward for more contents...Great job, keep it up..

Website Design Bangalore | Web Development Bangalore

AUGUST 20, 2016 AT 2:10 AM



beritaseputarobatherbal said...

I was greatly helped by this article thank you very much continued success for your

website biaya operasi katarak

AUGUST 21, 2016 AT 6:44 PM



Agaricpro herbal5 said...

Thanks for your sharing. We feel very pleased about that. You should also try their best games with our free today to get the sense of fun that brings. Thank you!

Obat Asma Untuk Anak

Obat Asma Pada Anak

Obat Sinusitis

AUGUST 21, 2016 AT 11:58 PM



Prakash Seo said...

Nice & very useful list.Thanks for the sharing.web designing jobs in hyderabad

AUGUST 24, 2016 AT 1:38 AM



Agaricpro 53 said...

Thanks for your sharing. We feel very pleased about that. You should also try their best games with our free today to get the sense of fun that brings. Thank you!

Obat Asma Untuk Anak | Obat Asma Pada Anak | Obat Sinusitis | Solusi Hernia Terpercaya | Obat Hidrokel Terbaik | Hernia Sembuh Total | Hernia Tanpa Operasi | Hidrokel Paling Aman |

Hidrokel Manjur

Sangat bermanfaat dan kami haturkan terima kasih

AUGUST 24, 2016 AT 6:13 PM



Nguyễn Quỳnh said...

Thank you for sharing information

Máy lạnh tủ đứng Mitsubishi Heavy

AUGUST 25, 2016 AT 6:40 PM



Milagro Belile said...

I ponder its a best station house to free website confabulation.

Website Ideas in Queensland

AUGUST 26, 2016 AT 4:52 AM



Trầ `n Đại Nghĩa said...

thank for you sharing rem cua

rèm vải

catalog rèm cửa

rem vai Hàn Quố ´c

rèm roman

rem cua so

rem van phong

rèm phong tho

rem phong khách

rem phong ngu

rèm phòng cưới

rem phong tre em

AUGUST 26, 2016 AT 6:31 AM



Agaricpro 53 said...

Thanks for your sharing. We feel very pleased about that. You should also try their best games with our free today to get the sense of fun that brings. Thank you!

Obat Asma Untuk Anak | Obat Asma Pada Anak | Obat Sinusitis | Solusi Hernia Terpercaya | Obat Hidrokel Terbaik | Hernia Sembuh Total | Hernia Tanpa Operasi | Hidrokel Paling Aman | Hidrokel Manjur

Sangat bermanfaat dan kami haturkan terima kasih

AUGUST 26, 2016 AT 8:47 PM



Bobbi Cardenas said...

Jelly Gamat QnC
cara mengobati kista
Pengobatan penyakit asam urat
Jelly Gamat QnC
Suplemen untuk kesehatan mata
Suplemen pelangsing tubuh terbaik
Suplemen penambah gairah seksual
Cara mengatasi hernia
Jelly Gamat QnC
Cara mengatasi maag dan asam lambung
Ciri ciri kanker payudara
Penyebab penyakit stroke

AUGUST 31, 2016 AT 7:18 PM



Lodha Meridian Hyderabad said...

Nice Blog, Thanks for sharing.
Lodha Meridian
Mantri Energia
Goyal Orchid Whitefield

SEPTEMBER 2, 2016 AT 3:12 AM



Agaricpro 53 said...

Whenever contemplating very best product as well as me personally, basically devote the product this amazing site daily trained with offers quality product, enjoy it!
Obat Darah Tinggi | Pengobatan Darah Tinggi | Pengobatan Hernia | Pengobatan Hidrokel | Cara Mengobati Darah Tinggi
Semoga Menjadi Amal Shaleh

SEPTEMBER 3, 2016 AT 7:46 PM



Unknown said...

nice blog

SEPTEMBER 8, 2016 AT 12:42 AM



Mantri Energia said...

Nice Blog....Thanks for sharing the imformation
Mantri Energia
Goyal Orchid Whitefield
Lodha Meridian

SEPTEMBER 12, 2016 AT 2:00 AM



Nikita Patel said...

Its a good informative post that you have shared and appreciate your work for sharing the information. 2 line shayari
whatsapp status

SEPTEMBER 13, 2016 AT 1:19 AM



Pushpa Anjali said...

Nice Blog
Prestige Lake Ridge Bangalore

Prestige Lakeside Habitat

Prestige Kew Gardens

SEPTEMBER 13, 2016 AT 11:43 PM



Agaricpro 53 said...

Sangat Berguna dan sangat luar biasa. Verry Nice and good Article

Hernia dan sangat Hernia luar biasa Hernia bermanfaat Hernia terampil dan bagus Hernia bisa sembuh loh Hernia pada anda Hernia hanya dengan 1 obat

Semoga Bermanfaat

SEPTEMBER 16, 2016 AT 12:14 AM



Agaricpro 53 said...

Sangat Berguna dan sangat luar biasa. Verry Nice and good Article

Hernia secara baik dan Ayo Berqurban yuk ah capcus Fitnah Wanita awas hati-hati Hernia sembuh total Hernia awas pula dengan Hernia pakai lah segera Obat Ampuh ini dia Hernia

langsung hebat cepat Hernia benar tak kang Deni Wahab

Semoga Bermanfaat

SEPTEMBER 16, 2016 AT 12:14 AM



Agaric Pro51 said...

Good, and its verry inportant and good article and the best Author

10 Kisah Cinta | Harta Haram.? | Obat Hidrokel | Hidrokel Alternatif | Buah Zakar Sebelah

Thank you, and good forever

SEPTEMBER 19, 2016 AT 11:51 PM



Karen Jain said...

At Jain Technosoft we aim at creating web designs that will connect the visitors to the page. We understand that a professional web design is not just limited to great graphics, but also talks volumes about your products and services.

Web Design Company in Bangalore | Logo Design Company in Bangalore

SEPTEMBER 23, 2016 AT 5:02 AM



Nisha Kulan said...

Very nice and interesting post. Beautifully structured and very close to facts. I found myself lucky to go through it. Hope to have more post in future like this. Thanks for giving me the useful information. I think I need it!top consultants

SEPTEMBER 25, 2016 AT 11:09 PM



EliteLinkinsofts solutions said...

oracle db good.

Web Designing Company in Hyderabad

SEPTEMBER 30, 2016 AT 3:17 AM



nalina said...

great blog.Thanks for sharing the valuable info.Keep posting**Web Design Company in Kalyan Nagar | Web Design Company in Banaswadi**

OCTOBER 1, 2016 AT 12:36 AM



Agaricpro Backlink said...

Hello All, Howe Are you. thanks for admin

Your The best article. And gOOD cara mengobati buah zakar besar sebelah Angels Hidrokel

Menurut Para Ahli Find Pengobatan Hidrokel Resep Dokter best Cara Mengobati Hidrokel Aman

Guest and good.. Thanks

OCTOBER 4, 2016 AT 2:20 AM



Agaricpro 53 said...

Hello All, Howe Are you. thanks for admin

Your The best article. And gOOD cara mengobati buah zakar besar sebelah Angels Hidrokel

Menurut Para Ahli Find Pengobatan Hidrokel Resep Dokter best Cara Mengobati Hidrokel Aman

Guest and good.. Thanks

OCTOBER 5, 2016 AT 2:51 AM



obat kuat said...

terima kasih gan atas infonya ...

Vimax

Viagra

Obat Kuat

Obat Pembesar Penis

Klg

OCTOBER 7, 2016 AT 5:03 PM



Agaricpro 53 said...

Verry good, and Best Author

Obat Insomnia Paling Ampuh dan Aman

From Nothing For Some Thing

OCTOBER 12, 2016 AT 12:18 AM

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