IP address to geographic details

Document version	V1
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Document Change Control

Whenever a change needs to be made to this document, save this as a new version (eg. if the current document is ip_address_v1 the changed one should be saved as ip_address_v2). All changes should be made in this new version while recording the details of the changes in the table below.

All changes to this document will need to be coordinated with the team. Changes need to be forwarded to Professor Keith A. Williams, so that a new version can be published.

Revision History

Revision #	Change Request #	Affected Pages	Description of change	Date of revision
V1d1			Initial version	

1. CSV file

The CSV file at location https://github.com/bb245/IPtoCountry-Mapping/blob/master/master_ip_address.csv should be imported into a database or other data store. The below tabular columns provides the order of fields in the CSV file.

2. CSV Database Fields

Sl. No.	Name	Type	Description
1	Start IPv4 address	Unsigned integer	The first IPv4 address in a netblock.
2	End IPv4 address	Unsigned integer	The first IPv4 address in a netblock.
3	City	Varchar	The city or town name associated with the IP address.
4	Region name	Char	A two character ISO-3166-2 or FIPS 10-4 code for the state/region associated with the IP address. For the US and Canada, we return an ISO-3166-2 code. In addition to the standard ISO codes, we may also return one of the following: AA - Armed Forces America AE - Armed Forces Europe AP - Armed Forces Pacific We return a FIPS code for all other countries.
5	Postal code	Varchar	The postal code associated with the IP address. These are available for some IP addresses in Australia, Canada, France, Germany, Italy, Spain, Switzerland, United Kingdom, and the US. We return the first 3 characters for Canadian postal codes. We return the first 2-4 characters (outward code) for postal codes in the United Kingdom.
6	Latitude	Decimal	The latitude associated with the IP address.
7	Longitude	Decimal	The longitude associated with the IP address.
8	Metro code	Unsigned integer	The metro code associated with the IP address. These are only available for IP addresses in the US.
9	Area code	Char	The telephone area code associated

with the IP address.

3. Integer representation of IPv4 address

The CSV file includes an integer representation of an IPv4 address. The first two fields, Start IPv4 address and End IPv4 address represent the IPv4 address range.

For an incoming IPv4 address the integer representation is determined by in-built function INET_ATON () in case of MySQL database (please refer to Append A for details) or similar functions for other databases. But for cases, where we cannot rely on database or the database won't provide such an in-built functions then the following pseudo-code is suggested for calculating the integer value of an IPv4 address.

For the sake of this discussion, let us consider an incoming IPv4 address as 174.36.207.186. To convert an IP address to integer value we need to break the incoming IPv4 address into four octets. The IPv4 address considered in our example could be broken as:

First octet (o1)	174
Second octet (o2)	36
Third octet (o3)	207
Fourth octet (o4)	186

Once the four octets are determined following computation would yield the integer representation of the IPv4 address.

integer_incoming_ip = (16777216 * o1) + (65536 * o2) + (256 * o3) + 1 *o4

[Where, $16777216 = 256^3$; $65536 = 256^2$; $256 = 256^1$; $1 = 256^0$]

Applying the above pseudo-code to our example the integer value representation of the incoming IPv4 address, 174.36.207.186 will be equal to **2921648058.**

After the integer value of the incoming IPv4 address is determined then corresponding record for geographical details needs to be fetched from the data store where the calculated integer value of the incoming IP address falls in between the CSV file fields - Start IPv4 address and End IPv4 address.

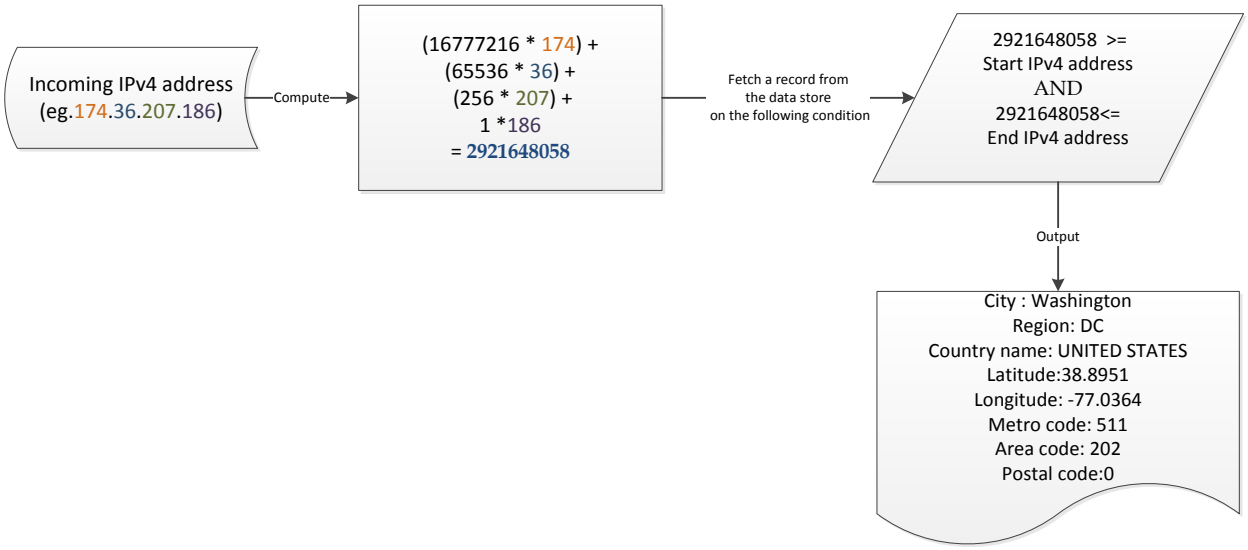
That is,

IPv4 integer value >= *start IPv4 address* **AND** *IP integer value* <= *end IPv4 address*

Next Section clearly shows the process flow and the geographical details that are retrieved.

4. IPv4 address information retrieval process diagram

Below flow diagram depicts the entire process of converting an incoming IPv4 address to integer value and obtain the Geographical details of the IPv4 address from the data store.



5. To derive IPv4 address from Integer representation

Here is the pseudo-code to convert the IPv4 address integer value into its IPv4 address:

```
integer_ip = 2921648058
o1 = int (integer_ip / 16777216 ) % 256;
o2 = int (integer_ip / 65536 ) % 256;
o3 = int (integer_ip / 256 ) % 256;
o4 = int (integer_ip) % 256;
```

Thus, obtained integer value for o1, o2, o3 and o4 needs to concatenated with a dot-separator ('.')

Appendix A

MySQL

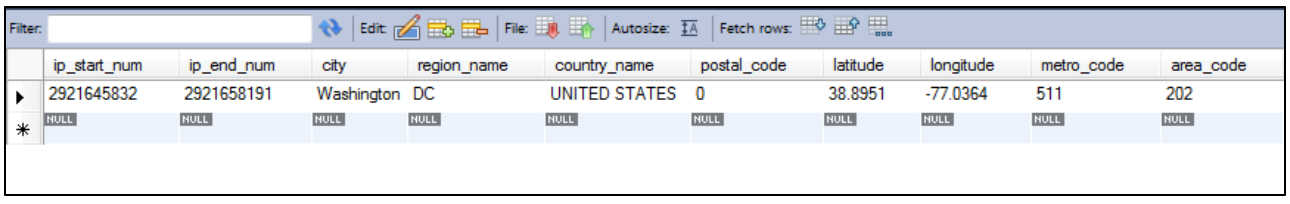
The CSV file is loaded into the table with the following attributes:

```
delimiter $$
CREATE TABLE `master_tab` (
  `ip_start_num` bigint(20) NOT NULL,
  `ip_end_num` bigint(20) NOT NULL,
  `city` varchar(80) NOT NULL DEFAULT '',
  `region_name` varchar(80) NOT NULL DEFAULT '',
  `country_name` varchar(80) NOT NULL DEFAULT '',
  `postal_code` varchar(6) DEFAULT NULL,
  `latitude` decimal(10,4) DEFAULT NULL,
  `longitude` decimal(10,4) DEFAULT NULL,
  `metro_code` char(10) DEFAULT NULL,
  `area_code` char(3) DEFAULT NULL,
  PRIMARY KEY (`ip_start_num`,`ip_end_num`,`city`,`country_name`,`region_name`)
) ENGINE=InnoDB DEFAULT CHARSET=utf8$$
```

To obtain the record from the database for an incoming IPv4 address following query needs to be executed:

```
 SELECT * FROM master_tab
WHERE INET_ATON('174.36.207.186') BETWEEN ip_start_num  AND ip_end_num  LIMIT 1 ;
```

The query would yield the following result:

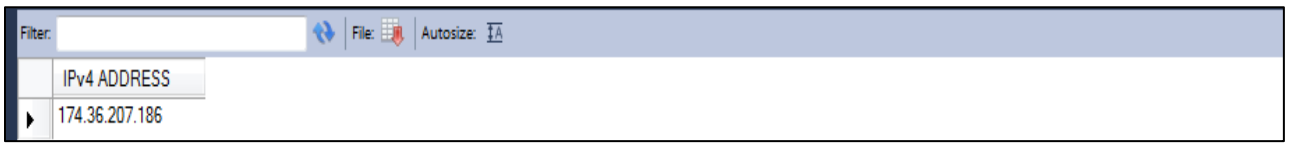


ip_start_num	ip_end_num	city	region_name	country_name	postal_code	latitude	longitude	metro_code	area_code
2921645832	2921658191	Washington	DC	UNITED STATES	0	38.8951	-77.0364	511	202
NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL

To obtain the IPv4 address for any integer value of IPv4 address the following query needs to be executed:

```
SELECT INET_NTOA (2921648058) AS "IPv4 address";
```

The query would yield the following result:



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